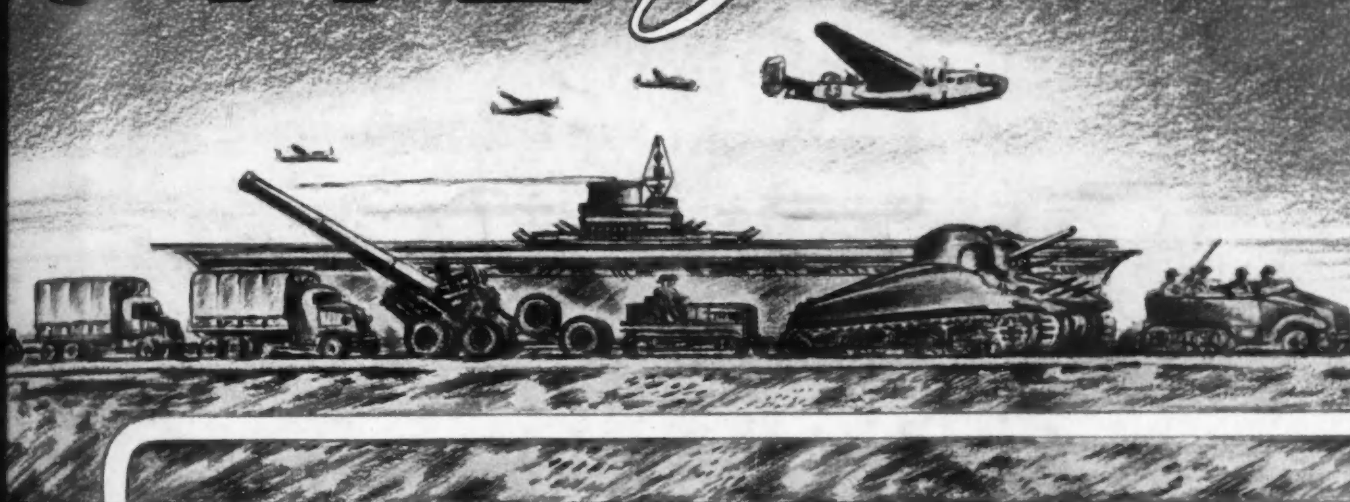
S·A·E Journal



SEPTEMBER 1944

Amphibian Army Truck Developments —Col. E. S. Van Deusen

Structural Flight Research —W. Lavern Howland

Truck Design—Guesses on How It Will Develop —B. B. Bachman

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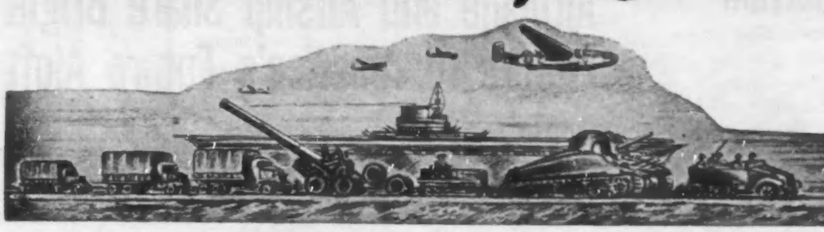
SOCIETY OF AUTOMOTIVE ENGINEERS

SAE JOURNAL *Pre-Prints*

THE SOCIETY OF AUTOMOTIVE ENGINEERS, INC.
29 W. 39TH ST., NEW YORK 18



News of the OCTOBER *Issue*

By Norman G. Shidle

In Reverse

EVER notice how much editors talk about what they put into their magazines and how little about what their readers take out? Practically all information dispensers have this same habit of looking through the wrong end of a telescope.

"Why, I TOLD him . . ." is both the amateur and professional alibi for having failed to get an idea out of one mind and into another. Most people talk as though their obligation had been completed when they toss an idea – often scantily clad or shabbily dressed – out into the world . . . and seem surprised that the doors of few minds ever are opened to the none-too-attractive orphan.

Government agencies are particularly afflicted with the push 'em out virus and allergic to analysis of resulting intake. Tons of data are spawned every day which would be extremely helpful to a variety of citizens provided a sufficient number of said citizens had the necessary combination of desire, capacity and initiative to take it in and put it to work. Too often a service is approved because it would be helpful if used. Too infrequently is it discarded because use-assurance cannot be obtained in advance.

If one-tenth the attention were given to opening minds for reception as is given to opening them for sending, the volume of knowledge actually *exchanged* in the world would be multiplied enormously.

Wartime Production Methods Make More Effective Use of Machinery

SMALLER factories, with closely supervised personnel producing higher quality products.

Conveyor systems and mechanical lift devices reducing machine cycle inventories and conserving storage room.

Fewer machines, largely automatic, enabling fewer workers with limited training to do more and better work.

These are among the byproducts of wartime aircraft engine production which, having stepped up output under emergency conditions to a degree once viewed as bordering upon the fantastic, may be expected to carry over into peacetime operations with equally astounding results.

Many of these byproducts represent air engineering improvements on land manufacturing processes. In other words, progress in processing accelerated by the springboard of the automobile industry's mass-production techniques.

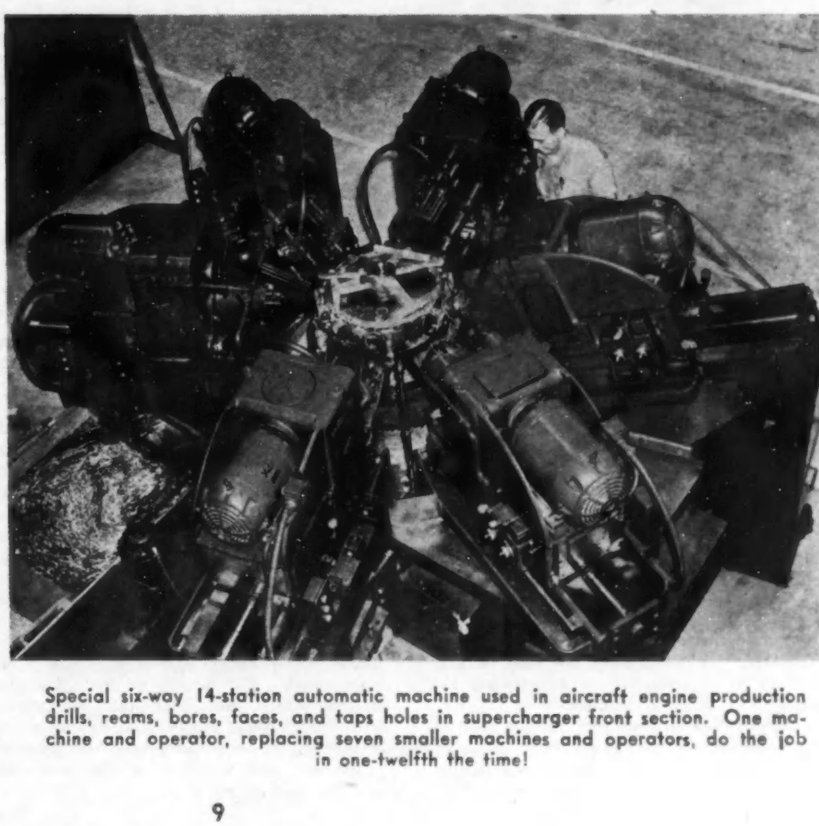
It seems only yesterday that mass-output of airplanes, engines, and parts was subject for engineering debate. Argument was then that aircraft, more like ships than motor vehicles, must be largely hand-fabricated.

Under the pressure of grave emergency in the way of global warfare, minds and processes were changed. Slowly at first, until the torrent of scrap and the trickle of useful products could be reversed. Then faster and faster, until huge automatic, multi-operational machines operated by women who donned their technical knowledge with their overalls for the duration, began large-scale production. After that the trickle which had become a torrent assumed the proportions of a flood – and drowned argument as well as Axis.

Along with this metamorphosis in aircraft and aircraft engine manufacturing apparently came a new approach to manufacturing

Continued on next page

Automatic Machines Save Time, Space, Labor



Special six-way 14-station automatic machine used in aircraft engine production drills, reams, bores, faces, and taps holes in supercharger front section. One machine and operator, replacing seven smaller machines and operators, do the job in one-twelfth the time!

Wartime Production

Continued from preceding page

methods in general, plus new respect for the engineering idea that automatic machinery makes possible greater production of better products at lower cost with less space, time, and labor. This may not be exactly a new idea, but its wartime applications definitely are new and resultful.

For a three-day shift the savings are estimated on the order of 4000 sq ft of space, 41 machines, $6000, 15 operators, 99 workers, and 800 production hours, Martin M. Holben, of Wright Aeronautical Corp., will suggest in October *SAE Journal*. Mr. Holben's article on aircraft engine production methods will, in fact, go beyond suggestion and present in accurately-descriptive detail the wartime development of production methods.

Vapor Lock is Critical In Operating Airplanes

OPERATION of airplanes at high altitudes and low atmospheric pressures is held responsible for the more serious effects of vapor locking experienced in aircraft than in motor-vehicle engines.

The comparatively simple fuel system of the motor vehicle has been found capable of handling 20 to 40 volumes of vapor per volume of fuel. Vapor lock may interrupt fuel flow in the complicated airplane fuel system when the vapor to liquid volume is unity or less, with all the serious results which powerplant failure implies in the air.

Ramifications of this serious aviation vapor-lock problem and summary of progress in the search for its solution will be presented in October *SAE Journal* by A. E. Robertson and Ralph Albright as compiled from a report of the CRC Coordinating Fuel Research Committee on studies of fuels and of fuel system phenomena which contribute to aviation vapor lock. Findings will include:

Aviation fuel systems vapor lock with the evolution of small amounts of vapor, which form far below the fuel's boiling point and which are ascribed to the presence of dissolved air.

Solubility of air in aviation fuel may be small, but vapor formation accompanying its evolution may be proportionately large.

Both the amount of air which a fuel will dissolve and the equilibrium amount of vapor which it will form for given initial and final condition of temperature and pressure may be predicted.

Study Behavior of Fuels To Find Vapor Lock Cure

DEVELOPMENT of methods of preventing vapor lock in airplane fuel systems gives evidence of increasing the number of examples of wartime engineering progress which have potential peacetime benefits. In fact, initial laboratory experiments which amount to studies of the behaviorism of fuels under simulated flying conditions are indicating the probability not only of preventing vapor lock, but of ascertaining the possibilities of its occurrence.

October *SAE Journal* will tell the story in the form of a report by W. H. Curtis and R. R. Curtis, both of Thompson Products, Inc. They will describe experiments in determining the vapor potential, or vapor-forming tendencies, of fuels under conditions which simulate flight.

The experiments give evidence of having overshot the objectives of confirming the observed behavior of a given fuel and of making quick comparisons between fuels to determine vapor potential. While further refinements in procedure are necessary, and additional tests alone can establish evaluation factors, the authors will contend they can show, in bottles, fuel samples which reveal vapor potentialities to be expected from given fuels at given altitudes.

Airplane and Airship Share Bright Picture of America's Future Aloft

PICTURE of America's flying future evidently is sufficiently large to comprehend both the airplane, with its inherent advantages of faster speeds, and the airship, with its inherent advantages of greater capacities.

Transcending the controversies between the heavier-than-air and lighter-than-air schools of sky transportation is the fact that the two types of aircraft, both admirably effective, are available. Sharing alike every step in progress toward the ideals of great strength with little weight, maximum travel range with minimum fuel consumption, and perfection in design details, the two types appear to be complementary.

The airplane offers substantial advantages for shorter flights, the airship for prolonged, and round-trip, voyages. Where convenient landing fields accommodate frequent stops, the airplane obviously can be used with efficiency. Where great distances rule, as in the Pacific, use of the airship is indicated.

The airship is capable of carrying large cargoes on long round-trip voyages without refueling, at speeds greater than those of steamships. The airplane can fetch and carry cargoes for which there is pressing need, provided stop-over and refueling facilities exist. The airplane apparently can deliver more goods more quickly than the airship, but the slower airship can deliver more cargo per voyage, indicating a comfortable advantage in economy.

Interesting engineering discussion, expanding these and other data on the relative advantages of airship and airplane, will be presented in October *SAE Journal* by Lt.-Com. Neil MacCoull, of U. S. Naval Air Station, Lakehurst, N. J. Frankly recognizing the advantages and disadvantages of each type, Com. MacCoull will consider relative utility values with the idea of encouraging serious consideration of the use of both airship and airplane in the specific fields in which each serves best.

Intensely practical and applicable data will be offered as evidence, so that the use value of either craft for a specific transportation job may be easily evaluated. Pertinent will be discussion of increasing sizes and capacities of aircraft, the airship with its payload constantly two-thirds of useful load, the airplane meeting difficulties with both as its size is increased. Particularly interesting will be the carefully substantiated presentation of the theory that, when economy and capacity are ruling factors, the airship can deliver four times as much cargo as the airplane per unit of fuel consumed.

Select Steels From Hardenability Data

BASIC engineering philosophy underlying the current program for facilitating the selection of steels on the basis of physical properties rather than chemical compositions, and particularly to evaluate steels by hardenability, will be reviewed at length in October *SAE Journal* by A. L. Boegehold, of Research Laboratories Division, General Motors Corp.

Himself instrumental and influential in shaping the modern trend, Mr. Boegehold will explain how the requirements of engineering and economics fundamentally govern steel selection.

Pertinent relationship will be shown between the physical properties of the steel from which a part should be made, and the stresses which that part must withstand, with the engineer responsible for evaluation of stresses, decision as to required physical properties, and selection of the steel – all pending final service tests.

Prerotation Cuts Wear On Airplane Tires, But Adds to Complications

AIRPLANES appear to be having an astounding amount of trouble with excessive tire wear, information which may come as a surprise to those believing that tire trouble is an attribute only of ground vehicles.

The airplane's difficulty develops through sudden contact of tires with ground at speeds of 60 to 80 mph, and up. Screeches, smoke, jolts, and drag are produced, which indicate that the forces of inertia, friction, and combustion have suddenly gone to work. Cumulative result is the transfer of generous portions of treads from tire to ground, and even more serious trouble for unwary pilots.

Solution of this problem first to suggest itself was prerotation of landing wheels. Theory was that rotating wheels would make a rolling instead of abrupt contact, thereby dissipating certain forces and leaving more rubber on the treads. However, prerotation of airplane landing wheels involves complications. Enough, in fact, to busy some 100 inventors and experimenters for prolonged periods.

One of them will report some success and more complications in October *SAE Journal*. He is Henry F. Schippel, of The B. F. Goodrich Co., who will explain that by attaching wind-catching rubber vanes to sides of tires, landing wheels can be set to spinning at approximately two-thirds plane speed.

SAE Journal

Published Monthly by The Society of Automotive Engineers, Inc.

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AMPHIBIAN ARMY TRUCK DEVELOPMENTS

by COL. E. S. VAN DEUSEN
Office of the Chief of Ordnance – Detroit

AMPHIBIOUS warfare, involving one of the most difficult of all military maneuvers, that is, air attack and landing against a strongly defended shore line, is not a new development. Ancient history, and the Bible itself, records many campaigns which were dependent for their success on the ability of field commanders to move their forces across the water and secure bridgeheads on enemy-held territory from which further assault and eventual occupation of the conquered territory could be launched. There are also many recorded failures which attest to the difficulties surrounding this kind of military operation.

There is one great difference between the military invasions of the ancient days and similar operations in modern warfare. This centers on the logistics, that is, the supply problems involved. The Carthaginians and Caesar's Legions operated to all practical purposes as self-supporting forces, with little dependence on a system of supply reaching back to their home lands. Of course, this was largely due to the simplicity of their equipment, which could be replaced by local supply or sometimes even by manufacture by the troops themselves almost anywhere they happened to be, together with the extremely simplified requirements of the troops as far as subsistence was concerned. In fact, up to the period of the Napoleonic wars, military field forces were expected to, and were fairly well able to, "live off the land" with a minimum complication of supply problems. Warfare of today, however, is a vastly different operation due to two prime factors; first, the highly developed and complicated equipment which human ingenuity has invented and perfected for the purpose of killing off other human beings whose slant on life doesn't quite agree with one's own and, second, to the great numbers of troops thrown into the field of battle.

The operation of an assault against an enemy-held shore can be divided into three phases; first, the actual attack and landing, followed by the consolidation of the bridgehead against counterattack, and finally the expansion of the area held and the invasion and occupation of the enemy territory. Success in each phase is dependent on the timely supply to the attacking force of everything needed to overwhelm the defenders. The first and second phases do not usually involve movement of supplies very far off the shore, and can normally be supplied by landing barges which unload right on the beaches, but the third phase includes the stocking of supply points at some distance in from the shore, requiring land transport in dispersal away from the beaches. Some of the equipment which I shall describe is ideal for this purpose and can be truthfully credited with having recently and materially changed the basic tactics of assault landings.

The usefulness of truck and motor car equipment with amphibious ability has long been recognized by military authorities, not only for use in assault landing, but also for reconnaissance purposes over terrain broken by rivers, bays, inlets, lakes, and other water hazards. During the period following World War I and until early in 1940, many individuals, both military and nonmilitary, spent plenty of their time, mental energy, and funds, the latter practically all personal, on ideas for amphibianizing motor equipment. The Patent Office and War Department files on these ideas are surprisingly voluminous, but none of them proceeded beyond the model or preliminary experimental stage. Most of the ideas which were developed beyond the drawing board layouts were based on the use of auxiliary flotation attachments to be applied to conventional vehicles. A few contained the germ of what has now been accepted as the most useful combination, eliminating the necessity for any attachment or removal of auxiliary equipment when entering into or emerging from water operation. The great majority of these ideas were perfect examples of crackpot inventiveness, in some instances rivaling those which feature the Buck Rogers comic strip. It can be readily understood that the ability to pass directly from land to water operation and vice versa would be the only acceptable method for military use, since the time element is of prime importance in such situations.

Early in 1940, concurrently with the first official recog-

AMPHIBIOUS warfare is not new, but such operations are most difficult. New equipment developed since the United States entered the present war is mcterially assisting our successful amphibious assaults.

Two amphibious vehicles are available to our forces, the smaller one based on the famous jeep and the larger one on the 2½ ton, 6x6, truck. Their operation and maintenance requires special training and their production has indicated the advisability in future designs of considering vehicles as integrated mechanisms instead of separate chassis and bodies.

[This paper was presented at the SAE War Engineering-Annual Meeting, Detroit, Mich., Jan. 10, 1944.]

■ Fig. 1 – The jeep – officially designated "truck, ¼ ton, 4x4, amphibian"

nition of the desirability of securing amphibious characteristics in the now famous ¼-ton jeep, a young man with both vision and a practical approach to the problem, Roger W. Hofheins of Buffalo, N. Y., disclosed to the War Department a proposed design which he had developed. In its original form it was judged to be impractical for the military purposes foreseen, but Mr. Hofheins continued his work on his own responsibility, since the limited experimental funds in the hands of the War Department at the time were unavailable for expenditure on the project.

Early in 1941, however, as additional moneys became available in the expansion of the military supply program, a War Department project was initiated to amphibianize the jeep, and the National Defense Research Council was requested to carry out the plan. Unstinted credit must be accorded to P. C. Putnam of the NDRC and to Roderic Stephens, Jr., of the firm of Sparkman & Stephens, Inc. for the basic work involving hull form and constructional principles, and to C. F. Kramer and F. G. Kerby of the Ford Motor Co. for the detailed engineering involved in the volume production of the finally accepted amphibian jeep.

Mr. Hofheins' work, unfortunately, was based on an intermediate size of truck and, although his Amphibian Car Corp. eventually built several experimental models under government contract, the War Department decided to concentrate production efforts on the smaller size of vehicle as developed by the NDRC and later on a considerably larger version authorized after the practicability of the principles applied in both the Hofheins and jeep project was proved.

One stipulation in the characteristics required of the amphibian trucks adopted by the U. S. Army is that they shall perform on land commensurately with normal land vehicles of the same general size and cargo capacity. Also, in the interests of simplification, both of the spare and repair parts supply and of repair operation, they are required to be mechanically as nearly as possible like their land vehicle counterpart so that specialized training of repair personnel may be held at a minimum.

In this discussion of amphibious equipment, I am going to limit myself to wheeled amphibian trucks, although other types are in use by the Army, notably the so-called "alligator" or "water buffalo" full-tracked design, which is procured by the Navy.

Naturally, the gross vehicle weight of the amphibian version of a given truck will be increased considerably by the hull structure and the marine operating equipment which must be provided. In actuality, our amphibian trucks must be considered primarily as small boats endowed with land ability, rather than the converse. This approach has resulted in a great appreciation of the necessity for treating the vehicle as a complete entity rather than as a separate chassis and a separately mounted hull. I am of the opinion that much can be gained for application to our post-war truck and car designs from an appreciation of the interrelationship between the chassis and the hulls with special reference to their supplementing functions in carrying loads and stresses imposed. This is borne out by some of our field experience with wheeled vehicles entirely independent of the amphibian trucks which indicates that the chassis engineers and the body engineers are still too far separated in their respective fields to produce fully integrated mechanisms. In the amphibian, of course, a complete reversal of certain stresses and loads occurs when passing from the land into the water or vice versa.

■ Fast Action on "Swimming Jeep"

The successful demonstration of the experimental pilot models of the amphibian jeep early in 1942 was followed quickly by approval of a supply requirement and authorization to produce several thousand for issue to the Army.

Basically, the amphibian jeep (Fig. 1) is a standard ¼-ton truck chassis on a slightly lengthened wheelbase with the addition of an envelope hull so mounted that the normal unsprung elements oscillate outside of the hull. In a vehicle of such small size and with rather tight clearances of propeller shafts, axle housings, and the like, with the other chassis components, the modeling of the hull for the ¼-ton amphibian was quite a complicated problem of die work. Also, the supplementing functions of the hull and the chassis resulted in some rather interesting modifications of the original pilots. The final design provides a body space almost identical to that of the standard ¼-ton land vehicle and comparable cargo capacity.

Propulsion in the water is accomplished by a conventional propeller operating in a tunnel and driven through a special selective transfer case. Some additional propulsion can be obtained by rotation of the wheels when in the water. Water steering is accomplished by the front wheels and a conventional rudder.

Of course there is no inherent flotation existent in such

a vehicle other than the little which lies in the tires, and there is insufficient space within the hull to permit the inclusion of float tanks of sufficient displacement to be of practical value. Hence, considerable attention was given to power bilge pump equipment in the vehicle design and the amount of water which can be taken aboard without foundering is surprisingly large. Other peculiarly marine equipment includes an anchor, a power-driven winch, and an emergency hand-operated bilge pump.

The hull form is distinctly that of a scow. Naval architects long since proved that there is a definite limit of speed to which given forms can be driven through the water, and the form adopted, despite the irregularity of the cutouts in the bottom hull panel and the water drag of the wheels, axles, and so on, approaches far closer than would be the normal expectancy to the maximum which can be secured from the power displacement ratio in similar scow forms. The blunt-nosed bow actually assists the land performance of the truck in slithering across ditches. The under-hull clearance is practically the same as for the conventional truck.

One interesting feature of these amphibian trucks is the provision for engine cooling, definitely an unconventional problem for a land vehicle. Conventional practice is used in so far as the engine and radiator coolant circulation is concerned. The cooling air is, however, led through ducts arranged so that the intake may be secured either from a bow-deck ventilator for normal operation or from the driver's compartment when the deck inlet might be smothered in water.

The amphibian jeep finds its principal use in military application for reconnaissance purposes. Its limited cargo capacity, small size, and low freeboard, do not lend themselves to satisfactory results as a ship-to-shore ferry in supply service, but it has proved to be very valuable for ferrying personnel and in the patrol of beaches. General Eisenhower made his first landing on Sicily from one of these little trucks.

In the larger field of truck, the duck, which is based on the standard 2½-ton, 6x6, cargo truck of 164-in. wheelbase, is to date the outstanding contribution in the motor truck field to the solution of our amphibious warfare problems. See Fig. 2.

The duck, accidentally acquiring this popular name through the amusing result of the normal process of model designation by Yellow Truck and Coach, has enabled our overseas task forces in certain tactical situations to perform unbelievable feats in the discharge of cargo from transports and supply ships on invasion shores, and, in some instances, to do a faster job than was possible with the same ships alongside an average harbor pier. I cannot at this time reveal the methods used, beyond the fact that the duck's ability to handle its loads right across beaches and direct to inland supply dumps, eliminating the multiple handling operations onto and away from dockside, is the key to the remarkable performance in tonnage moved. The enemy have, in several instances, recognized the importance of this piece of equipment by specific mention of claimed damage to amphibian trucks in news releases. The most recent reference of this sort appeared in a Domei dispatch not very long ago, in which one duck was listed and claimed as being destroyed by Jap operations against our landing at Arawe, New Britain, along with landing barges, destroyers, and transports claimed to be damaged or destroyed.

The project of developing the duck was initiated very shortly after the release of orders for quantity production of the amphibian jeep, in April, 1942. In view of the experience gained and success attained in the ¼-ton field, the same agencies, that is, the NDRC and Sparkman & Stephens, Inc., carried out the supervision of the detailed work performed at Yellow Truck and Coach. C. O. Ball, Everett Allen, W. F. Klein, and E. H. Todd, and their assistants, should receive special mention as the "spark plugs" who were directly responsible in the factory at Pontiac for the production and successful demonstration of the first experimental pilot model in just six weeks' time. Immediately following the first demonstrations of the pilot duck, quantity production was authorized and has continued in increasing numbers ever since.

Jeep Experiences Aided "Duck"

The lessons learned from the ¼-ton project assisted materially in applying amphibianization to the 2½-ton, 6x6, and the proportionately larger displacement of the duck hull (Fig. 3) greatly simplified many of the problems which complicated the jeep project. I do not mean to imply in any sense that the duck was a simple problem, for the increased size in itself brought many new obstacles into the engineering and manufacturing picture. Not the least of these were the direct interference and competition which developed between the duck program and the small boat and landing craft programs of the Navy in so far as some of the peculiarly marine operating accessories were concerned.

Fortunately, the solution of one of the problems affecting operation of these vehicles across sand beaches and soft shore lines, the critical point in performance, had been

concluded on page 21

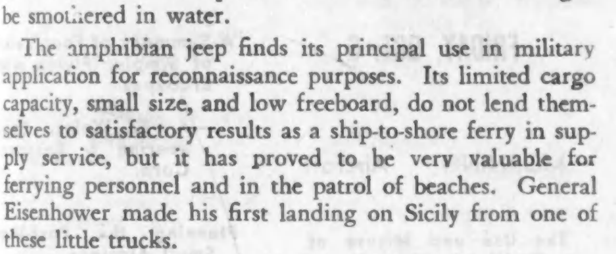


Fig. 2 – The duck – officially designated "truck, 2½ tons, 6x6, amphibian"

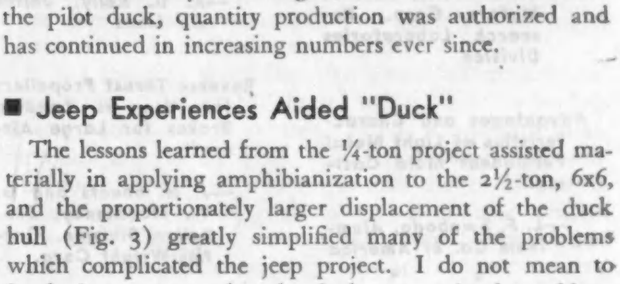


Fig. 3 – The duck hull envelope

SAE 1944 NATIONAL AERONAUTIC MEETING AND AIRCRAFT ENGINEERING DISPLAY

THURSDAY, OCT. 5

MORNING

Joint Aircraft & Engine

The Sonigage, A Supersonic Contact Instrument for Thickness Measurement

—W. S. Erwin, General Motors Corp., Research Laboratories Division

Advantages and Characteristics of Light Metal Permanent Mold Castings

—L. F. Sweboda, Aluminum Co. of America

MORNING

Transport—Design, Maintenance

The Design of the DC-4/C-54 Airplane

—E. F. Burton and Carlos Wood, Douglas Aircraft Co., Inc.

New Concepts of Airline Aircraft Maintenance

—R. C. Stunkel, Lockheed Aircraft Corp.

AFTERNOON

Accessories

Post-War Accessory Equipment Design

—W. A. Reichel and David Gregg, Eclipse-Pioneer Division, Bendix Aviation Corp.

A Means for Warning of Incipient Breakdown of Smooth Airflow over Airfoil Surfaces

—R. D. Kelly, United Air Lines

Reverse Thrust Propellers for Use as Landing Brakes for Large Aircraft

—J. H. Sheets and G. W. MacKinney, Propeller Division, Curtiss-Wright Corp.

AFTERNOON Engine

Aircraft Bevel Gears

—L. J. O'Brien, Gleason Works

Oil System Problems at High Altitude

—W. L. Wheeler, North American Aviation, Inc.

EVENING Engine

The Fundamentals of Flight Induced and Forced Cooling

—J. H. Brewster, III, United Aircraft Corp.

Analysis of Methods Available for Improving Flight Performance of Aircraft Engines Below Critical Altitudes

—Andre Planiol, Ranger Aircraft Engines

FRIDAY, OCT. 6

MORNING Aircraft

The Use and Misuse of Plastics in Aircraft

—Capt. Russell M. Houghton, AAF Materiel Command

Research and Tomorrow's Aircraft Undercarriage

—R. W. Brown, Firestone Tire & Rubber Co.

MORNING

Transport—Operation

Symposium: Flight Operational Problems and Characteristics of Transport Airplanes

—R. C. Loomis, Transcontinental & Western Air, Inc.

—Ralph S. Johnson, United Air Lines

—M. G. Beard, American Airlines, Inc.

—Capt. H. J. Chase, Pan American Airways System

AFTERNOON Aircraft

A Summary of Four Years of Simpler Flying with Ercoupes

—F. E. Weick, Engineering & Research Corp.

Planning the Post-War Small Airplane

—A. G. Tsongas, Stinson Division, Consolidated Vultee Aircraft Corp.

AFTERNOON Engine

Radio Interference and the Aircraft Engine

—J. K. Rudd and Westcott Heath, Jr., Wright Aeronautical Corp.

Fuel Injection for the Aircraft Engine

—F. J. Wiegand and D. W. Meador, Wright Aeronautical Corp.

OCT. 5-7, 1944
BILTMORE HOTEL
LOS ANGELES, CALIF.

EVENING — General

Symposium: Environment of Airplane

High Altitude Factors in Flight Testing

—Marvin Michael, Boeing Aircraft Co.

Aircraft Environment, Thermal Effects

—T. N. Floyd, Douglas Aircraft Co., Inc.

Humidity Effects on Airplane Equipment Performance

—B. A. Rose, Lockheed Aircraft Corp.

A Current Outlook on the Effects of Dynamic Loads on Aircraft

—R. L. Schleicher, North American Aviation, Inc.

Presentation of Manly Memorial Medal

—J. F. Schirtzinger, Douglas Aircraft Co., Inc.

Application of High Production Methods to Reduced Production

—J. N. Foster, Curtiss-Wright Corp.

Metallurgical Control of Aircraft Forgings

—A. J. Pepin, Wyman-Gordon Co.

MORNING

Transport—Passenger & Cargo

Passenger Comfort in Commercial Aviation

—A. D. Tuttle, M. D., Medical Director, United Air Lines

Cabin Interiors

—Henry Dreyfuss, Industrial Designer

★ ★ ★

SATURDAY, OCT. 7

MORNING

Aircraft Production

The Design of Integral Fitting Spar Caps

DINNER DANCE

Saturday Evening

★ ★ ★

continued from page 19

indicated early in 1942 by results obtained in sand dune test operations conducted by our Desert Proving Ground under the supervision of Lt.-Col. Jean E. Engler. These data were the basis for early decision to equip the duck with large cross-section, single tires in lieu of the 7.50-20 dual rears furnished as regular equipment on the standard land vehicle. This duck tire and wheel equipment, by the way, is also available as field modification material for adapting the standard land trucks to special operating conditions where ground flotation is of prime importance.

Basically, the same engineering principles applied in the amphibian jeep are used in the construction of the duck. Conventional relationship exists between all the normal chassis units, and the sprung elements oscillate outside of the hull. The water propeller operates in a tunnel, and the steering in the water is accomplished by the front wheels and a rudder. The truck handles comparably in smooth water to a heavy motor boat of the same size, about 31 ft in length by 8 ft beam. In heavy seas and surf it surpasses the performance of an ordinary power launch, due to its low epicentric height and to the double keel and stabilizing effect of the free-hanging wheels.

I said previously that these amphibian trucks should be considered primarily as boats. They certainly are hybrids and some people may argue that my position is incorrect, in view of their similarity to conventional trucks in so far as the land operating components are concerned. Their successful handling and maintenance, however, requires more than a casual understanding of small boat principles by the operators and maintenance crews.

It is a foregone conclusion that almost all truck operations in an active combat theater will involve overloading of cargo equipment to whatever extent is necessary to accomplish the job in hand. This is equally true with amphibian equipment, and emphasizes the special consideration which must be given to the use of these vehicles, since their water displacement ratio permits water-borne loading on smooth water, especially with high concentration items such as ammunition, far in excess of the safe limits of axle and tire loads for land operation.

While we know that our enemy to the east has been working on the development of amphibian truck equipment since the early '30's, available data fail to disclose any marked success on their part which approaches that of our equipment in this field. We have information pertaining to certain matériel of this type which has been captured by Allied forces and information from other sources pertaining to enemy efforts, but such data merely confirm the superiority of our equipment. Nothing has appeared in our Pacific theaters to date which would indicate the availability of similar equipment to our enemies.

While it would be most interesting to include in this paper and for the written record a detailed description of the construction principles and the means used to solve some of the unusual problems which arose in the development and production of these queer hybrids, it can be appreciated that such information cannot be disclosed for publication at this time. When we have finished our job of erasing the influences of Nazism and Bushido from the human race, maybe another paper which will present and discuss these details, now still classified information, can be scheduled by the Society. For the present, however, only the illustrations which appear herewith can be released for publication in the *Journal*.

News..
..OF THE SOCIETY

SAE COMPLETES AERO MATERIALS CROSS INDEX FOR UNITED NATIONS

TABLES to assist in the selection of interchangeable and substitute materials for the maintenance of aircraft, engines, and accessories where specified materials are not obtainable, have just been published by a joint U. S. and British Commonwealth of Nations effort with the SAE Materials & Processes Subdivision.

Issued as the SAE Aeronautical Information Report No. 8, the 164-page compendium is a cross index of material specifications, and represents one of the most effective inter-Allied standardization efforts to date.

The project was initiated about a year ago when representatives of the Society of British Aircraft Constructors, Ministry of Aircraft Production, British Air Commission, and the SAE discussed the need for such a cross index to accelerate maintenance of aircraft, engines, and parts in combat zones the world over.

The first step was preparing the U. S. material. This was undertaken by a special SAE committee headed by J. B. Johnson, AAF Materiel Command, with J. J. Bowman, Carter S. Cole, and Edwin Joyce, War Production Board; B. Clements, Wright Aeronautical Corp.; Major S. D. Daniels, Working Committee of the Aeronautical Board; Eric Dudley, Curtiss-Wright Corp. Airplane Division; Flight Lt. D. G. Moffitt, British Air Commission; N. E. Promisel, Navy Bureau of Aeronautics, and H. W. Schmidt, Dow Chemical Co., as members.

Then Lt. Moffitt flew with the material to Great Britain, where it was coordinated with a committee of the leading British aeronautical metallurgists with the cooperation of the British Ministry of Aircraft and representatives of the British aircraft industry committees. The data were completely checked by these experts.

The draft was then completely reviewed and revised to include additional data supplied by the British authorities as soon as Lt. Moffitt completed his round trip by air.

This draft was then completely edited by Capt. C. W. Cole, Air Service Command, and with additional handbook material was published by the Air Service Command, AAF, as an AN Aeronautical Bulletin, a restricted document.

The SAE Aeronautical Information Report No. 8 is available at $1.00 per copy.

Gen. Frank Commends SAE Aeronautical Job

Following a pre-publication review of the cross index of U.S.-British aeronautical material specifications developed under SAE auspices (as described above) Major-Gen. W. H. Frank, then commanding general of the Air Service Command, commended the SAE highly in a letter written June 12. Gen. Frank wrote in part:

"It is my desire to express my appreciation for the outstanding achievement of your Aircraft Materials & Processes Subdivision which, through its cooperation with the British Society of Aircraft Constructors, the British Ministry of Aircraft Production, the British Air Commission in Washington, and the Governmental agencies of Canada and Australia, prepared the list of interchangeables and substitutes for metals . . ."

He specifically thanked by name the members of Mr. Johnson's committee who had worked on the project with Capt. C. W. Cole of the Air Service Command, adding:

"It is my sincere hope that the Society will continue to assist the Services on this very important project."

SAE MEMBERSHIP More In and Less Out; Result—Highest Total

THE total of members dropped or resigned from SAE rolls so far this fiscal year as compared to last has declined substantially, while the number reinstated or qualified as new members has increased substantially, it is revealed by Membership Department records for Oct. 1, 1943 to July 31, 1944.

This two-way advance has resulted in a membership roll at this time larger than at any previous point in the history of the SAE. Exclusive of 1105 enrolled students, the Society's membership at the beginning of August stood at 11,525—with every category of membership at higher levels than last year. Full member grade is currently held by 5090; associate grade by 3094; and junior grade by 2381. It is interesting that foreign members now total 440 as against 408 at this time last year, despite a variety of correspondence and monetary difficulties involved in maintenance of many foreign memberships in war time.

SAE JOURNAL FIELD EDITORS

Baltimore – No Appointment
Buffalo – Charles E. Hathorn
Canadian – Warren B. Hastings
Chicago – Austin Stromberg
Cleveland – Merrell A. Wod, Jr.
Detroit – W. F. Sherman
Indiana – Harlow Hyde
Kansas City – J. R. Kessler
Metropolitan – Duis W. Meador
Mid-Continent – No Appointment
Milwaukee – E. H. Lichtenberg
New England – James T. Sullivan
No. California – Edward J. McLaughlin
Northwest – D. M. Trepp
Oregon – W. G. Auer
Philadelphia – James J. Crookston
Pittsburgh – Murray Fahnestock
St. Louis – Geoffrey C. Hazard
So. California – Thomas D. MacGregor
So. New England – Henry Clay Osborn
So. Ohio – R. L. Camping
Syracuse – No Appointment
Texas – Tom Ashley
Washington – Fred Fielding
Wichita – No Appointment
Colorado Group – No Appointment
Mohawk-Hudson Group – No Appointment
Muskegon Group – Douglas W. Hamm
Peoria Group – Harry W. Fall
Twin City Group – Frank A. Donaldson, Jr.

Army Asks W.E.B. Aid In Parasite Problem

SLIDING up the thermometer from winterization of motor equipment, the SAE War Engineering Board has been requested by the Army Ordnance Department to advise it on methods to preserve Army equipment against the ravages of fungus in the far South Pacific.

The insidious action of the South Pacific parasite is caused by an acidious secretion which attacks plastics, insulation, etches nonferrous metals and even glass, officers of the Ordnance Department reported.

Sponsor of the project is Louis Thoms, General Motors Central Engineering Department, and chairman of the project's committee is William M. Phillips, Research Laboratories Division, General Motors Corp.

Life of fighting equipment has been materially shortened by the action of the fungus, and the maintenance problem has been magnified, members of the SAE W.E.B. were told.

Research of lasting value to the automotive industry is expected to accrue from this assignment, in view of the expected export business of the automotive industry.

Radio equipment, unprotected against the growth of the parasite, has been put out of commission within a few weeks. Insulation material suffers rapidly by the action of the mold.

SAE STANDARDS ISSUED On Low-Contour Aero Tires

TRACING the trend toward the new series of low contour airplane tires, the SAE Aircraft Accessories & Equipment Subdivision's Committee A-5, Aircraft Wheels, Brakes, and Axles, has obtained approval by the SAE Aeronautics Division for publication of six envelope Aeronautical Standards, AS 181 to 186. The new type of wheel offers less drag and requires less space in the fuselage when retracted in flight.

The work was a combined effort by the Committee and the Tire and Rim Association which worked out the sizes of the tires and rims. These were then coordinated by Committee A-5 with the Association, and with the six manufacturers involved until agreement was reached on envelope dimensions of the wheels, axle sizes, bearing locations and sizes.

Effect Coordination

Again a coordinating task was undertaken to obtain the agreement of the Army, Navy, and the airframe manufacturers as represented by the National Aircraft Standards Committee of the Aeronautical Chamber of Commerce of America.

Another project undertaken by Committee A-5 is one of standardizing small sized wheels. This will involve coordinating the design of various makes so they will be interchangeable in the interest of low cost manufacture and maintenance.

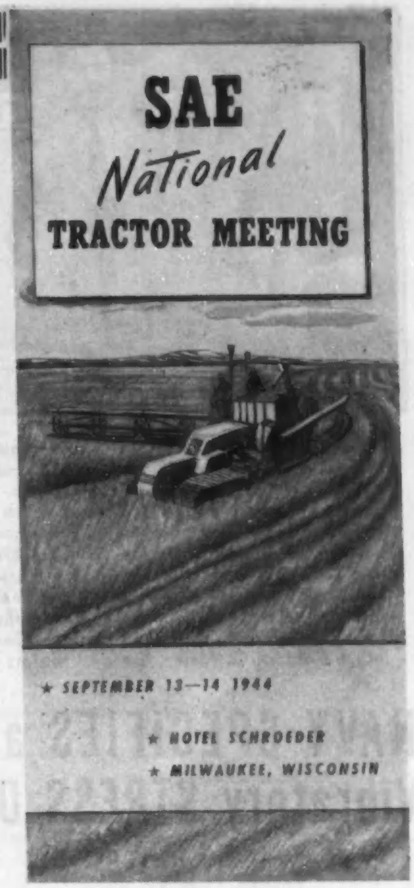
Members of the committee are Charles Hollerith, Hayes Industries, Inc., chairman; Eric Dudley, Curtiss-Wright Corp. Airplane Division, the NASC liaison; F. C. Frank, Bendix Products Division, Bendix Aviation Corp.; B. H. Shinn, Firestone Aircraft Co.; F. D. Swan, Goodyear Aircraft Corp., and Farle Stewart, Glenn L. Martin Co.

Aero Circuit Breaker Subcommittee Forming

UNDER the terms of an agreement between the American Institute of Electrical Engineers, National Electrical Manufacturers Association, National Aircraft Standards Committee of the Aeronautical Chamber of Commerce of America and the SAE, the new permanent Subcommittee on Circuit Breaker Standards of SAE Committee A-2 on Aircraft Electrical Equipment will coordinate, for the Armed Services, these interests (*SAE Journal*, August, p. 29) under E. G. Haven, a member of E-2, General Electric Co.

Wide Representation

Indicating the cross section representation of this new Subcommittee were these first appointees: J. C. Cunningham, Jr., Westinghouse Electric & Mfg. Co., representing the AIEE; Gideon Du Rocher, Square D Co., for the Aircraft Electrical Council of NEMA; V. G. Vaughan, Spencer Thermostat Co., H. B. Phillips, Cutler-Hammer Co., and O. F. Olsen, Grumman Aircraft Engineering Corp., representing the NASC Electrical, Radio, and Instruments Subcommittee. I. E. Ross, Jr., technical adviser, NEMA's Aircraft Electrical Council, is Mr. Du Rocher's alternate. The Army will participate without being formally represented on the committee.



WEDNESDAY, SEPT. 13

MORNING — Gear Teeth

Elmer McCormick, Chairman

Be Vigilant . . . and Mum
—Major Albert J. Stowe, G.S.C., representing Assistant Chief of Staff, G-2

The Design of Gear Teeth
—Fred Bohle, Illinois Tool Wks.

Prepared discussion by:
—F. L. Knowles, Gleason Works

AFTERNOON — Fuels

L. B. Sperry, Chairman

Fuel Requirements for Tractors
—A. T. Colwell, Thompson Products, Inc.

Prepared discussions by:
—D. P. Barnard, Standard Oil Co. (Ind.)
—Earl Ginn, Continental Motors Corp.

THURSDAY, SEPT. 14

MORNING — Fuel Injection

J. M. Davies, Chairman

The Application of Gasoline Injection to Tractor Engines
—H. O. Hill, American Bosch Corp.

Prepared discussions by:
—R. K. Weldy, Ex-Cell-O Corp.
—A. W. Pope, Jr., Waukesha Motor Co.

AFTERNOON — Steels

Walter F. Strehlow, Chairman

Automotive Steels – Past, Present and Future - from the Engineering Standpoint
—H. B. Knowlton, International Harvester Co.

Prepared discussions by:
—John Mitchell, Carnegie-Illinois Steel Corp.
—G. C. Riegel, Caterpillar Tractor Co.
—W. H. Naegely, J. I. Case Co.

DINNER

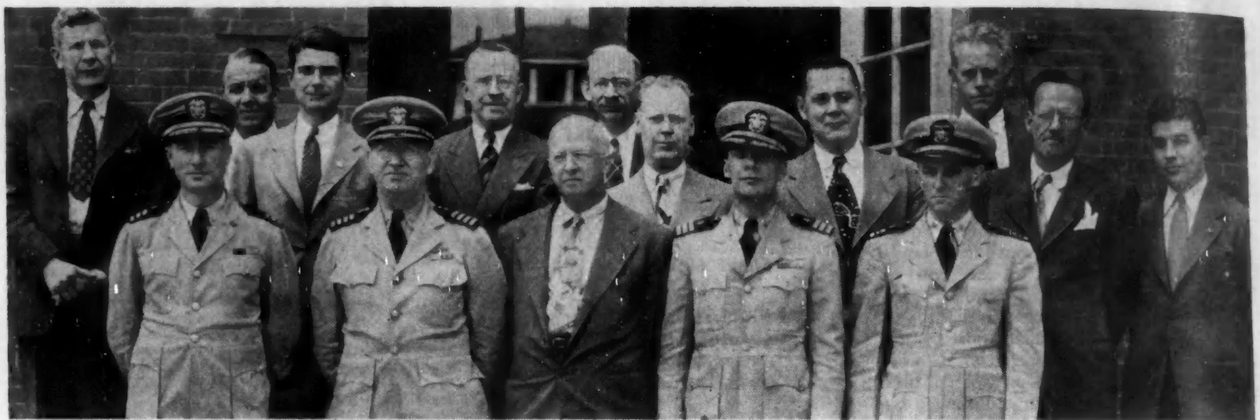
O. R. Schoenrock, chairman

C. E. Frudden, toastmaster

Tractors of Tomorrow
—William S. James, President, SAE

Agriculture's Post-War Opportunities

—WHEELER MC MILLEN
Editor-in-Chief, *Farm Journal*



Navy officials invited the SAE War Engineering Board's Torsional Vibration Committee to meet July 18 and 19 at the Portsmouth Navy Yard. The committee met with Navy officers on the project, Progress Report No. 1 of which has been completed. The final report is under way. The research program was requested of the SAE by the Navy several months ago. Front row (left to right): Com. J. P. DenHartog, USN; Capt. L. F. Small, USN; Carl G. A. Rosen, chairman of the SAE W.E.B. Torsional Vibration Committee, Caterpillar Tractor Co.; Com. Thomas G. Reamy, USN; and Lt.-Com. Carl J. Vogt, USN. Rear, left to right: J. O. Almen, General Motors Research Laboratories Division; John A. C. Warner, secretary and general manager, SAE; L. F. Hope, General Motors Research Laboratories Division; E. C. Magdeburger, Bureau of Ships, Navy Department; F. P. Porter, Fairbanks, Morse & Co.; L. M. Ball, Chrysler Corp.; T. C. Van Degrift, General Motors Research Laboratories Division; Don Blanchard, SAE staff; S. T. Foresman, Chrysler Corp., and J. F. Millan, Caterpillar Tractor Co. Serving with Mr. Rosen on the Committee are: Messrs. Ball, Porter, and Van Degrift, and Capt. Small, G. F. Dashefsky, Brooklyn Navy Yard, Prof. F. M. Lewis, Massachusetts Institute of Technology, and Lt.-Com. Vogt are consultants

NAVY SPECIFIES a Limiting Vibratory STRESS OF SHAFTS

by Capt. Lisle F. Small, USN
Bureau of Ships

MY discussion of Navy diesel engine problems (*SAE Journal*, May 1944, p. 198) at the Cleveland Meeting on June 2, 1943, has resulted in the formation of the SAE Torsional Vibration Committee of the War Engineering Board, and I have been requested to elaborate on the torsional vibration problem and present a justification of the method of dealing with it adopted by the Bureau of Ships.

The position of the Bureau with respect to setting up specification requirements for shafting to assure reliable operation of various machinery installations, of which a reciprocating engine may be a part, can best be stated by a review of the background.

First of all, the Bureau's experience with shaft breakages dates back to the days of steam reciprocating engines. It is easy to see now why during the last war many a propeller was lost at sea, but at the time the usual diagnosis of the trouble was imperfection of material, or lack of alignment, or both. Unfortunately for the development of the art of vibratory stress investigation the steam turbine replaced the reciprocator, and shaft casualties disappeared.

It was only when the diesel engine became the principal means for propelling submarines that shaft breakages came back into the picture. These breakages were not limited to the propeller shaft, since frequently crankshafts would break, usually at or near the last crank. In due time the theory of torsional vibrations was developed and based on its deductions many different devices were tested during an interval of about 10 years. In two particular naval installations which were designed, without the blessing of the new theory, no practical solution was found for their torsional shortcomings. In another type of installation the Bureau insisted on an arbitrary increase in the size of the crankshaft, and these submarines with the same powerplants have survived and are active in this war although the vessels and engines are close to 20 years old.

In submarines, as one can well imagine, the designer has very little freedom as to the location of the engine with its heavy clutch to the electric motor and the propeller shafting when a direct-drive propelling plant is used. Therefore, in the old days the presence of critical speeds which have to be avoided had to be tolerated. The elimination of critical speeds was one of the potent reasons for making the modern American submarines of the electric-drive type.

The Bureau's torsional vibrations experience dates back to the time when the diesel industry insisted that it not be held responsible for the consequences of phenomena that were unknown to engineering science. Therefore these phenomena had to be classed as an "act of God" in the language of the contract so as to relieve the engine builder of the responsibility for shaft breakages. Furthermore, the Bureau's experience during the interval between the two great wars was limited to submarine installations, embracing a comparatively narrow dimensional range of crankshafts and the principal characteristics of diesel engines such as bore, stroke, rpm and the number of cylinders. It may be stated further that even the allowable design stresses of the crankshafts, their material and stress concentration characteristics were within a narrow range imposed by the submarine service.

Coupled with the obviously heavy responsibility of the Bureau for reliable performance of naval machinery, the aforementioned narrow range of engine variables and the practical constancy of such crankshaft variables as affect its life, when subject to torsional vibrations, made the additional stress, imposed by torsional vibration alone, a thoroughly practical yardstick for defining the reliability of crankshaft performance.

In justification of the figure for such an allowable additional stress, it may be stated that as long as our measuring devices (and all of our calculations are based on the data obtained by them) are subject to the inaccuracies which only recently upset the whole structure of carefully accumulated data of one of the engine builders, or to put it in other words, as long as torsiographs are what they are, and even the best of engineers can be misled by their indications, it is only prudent for the Bureau to be conservative in assigning allowable stresses.

On the other hand naval installations more than any others are pressed for weight and space and, therefore, there is no desire on the part of the Bureau to require any larger shafts or any lower vibratory stresses than are absolutely necessary to secure reliability of performance. In fact the very enthusiasm of the Navy for the deliberations of the SAE Committee is proof that the Navy is very anxious to reduce the celebrated "Safety Factor" by which the dying generation of engineers have tried to cover the inadequacies of means available to them for measuring the stresses and endurance limits of machinery parts. Finally we must not lose sight of the fact that the shaft breakages are not the only things we are trying to prevent when specifying the limiting stresses of torsional vibrations. Our experience has shown that we have been unable to operate certain engines because of excessive wear of gears driving camshafts, pumps, and so forth, because criticals interfere with valve timing, make the engine run roughly, and require excessive maintenance.

As a matter of fact, considering that we now have many, many thousands of diesel and gasoline engines of all types and sizes in the Navy – probably 30 to 40 million horsepower at this moment – we break exceedingly few crankshafts, but the skipper on the bridge feels that he cannot do his best in carrying out his orders when the chief engineer has the privilege of objecting

turn to p. 25

continued from p. 24

to some speeds on the ground that they are within prohibited critical ranges. An engine handicapped by prohibited bands of speed is a hated engine from the beginning. No commanding officer is ever satisfied with it.

Classifications Sought For Non-Rigid Plastics

PROGRESS is being made toward establishment of classifications and specifications for non-rigid plastics, similar to those now in effect for rubber, according to information deriving from the Non-Metallic Materials Division of the SAE Standards Committee.

Data looking toward this end are being developed separately by ASTM Committee D-20 and by a committee of the Society of the Plastics Industry, both of which plan cooperation with the SAE group. Interlocking personnel on the committees concerned with this project for the three organizations has brought about continued liaison between the groups, and the results of individual efforts to date probably will be ready for distribution and coordinated study within the SAE Division before the end of September.

Current integration of effort on this important work stems from resolutions addressed last January by the SAE Non-Metallic Division to ASTM Committee D-20 and to the SPI. These resolutions stated the decision of the SAE group to publish classifications for non-rigid plastics in the SAE Handbook as soon as classification adequate for that purpose could be developed; further the resolutions requested the cooperation of these two interested groups in working toward that end as quickly as possible.

Chairman of SAE Aircraft Committee A-6

B. R. Teree of the Airplane Division, Research Laboratory, Curtiss-Wright Corp., Buffalo, N. Y., was recently appointed chairman of SAE Committee A-6, Aircraft Hydraulic Equipment, SAE Aircraft Accessories & Equipment Subdivision.

Mr. Teree, who is also chairman of the National Aircraft Standards Subcommittee on Hydraulic Systems Installations, replaced Harry Kupiec, formerly of Glenn L. Martin Co. Mr. Kupiec, however, will still remain a member of Committee A-6.

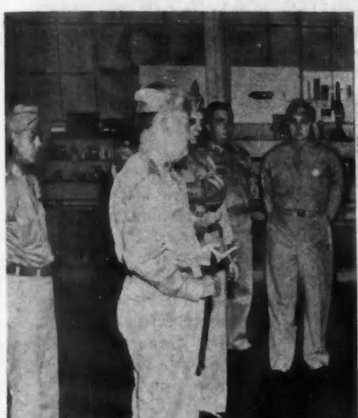
SAE COMMITTEES UNDERTAKE ENEMY EQUIPMENT TESTS

TO examine and report on elements of captured enemy vehicles is one of the most important projects on which the SAE War Engineering Board is currently engaged at the request of the Army Ordnance Department. Comprehensive in scope, the new project will round out the functional and design data on enemy wheel and tracklaying vehicles. The Steering Committee is headed by D. G. Roos, Willys-Overland vice-president, who is W.E.B. sponsor, and Paul Huber, chief engineer of General Motors Proving Ground Division, who is chairman of the technical committee. Mr. Huber's committee – divided into 11 technical subcommittees comprised of 55 automotive engineers – already has begun a complete survey of captured vehicles at Aberdeen Proving Ground.

The first trip to Aberdeen, June 29 and 30, was made by the chairmen of the technical subcommittees and Mr. Huber. On July 26 and 27, about 30 members of six technical subcommittees and Messrs. Roos and Huber made a detailed inspection of the equipment to segregate the items of unusual interest for examination. The remaining five technical committees inspected units assigned to them on Aug. 9 and 10.

From these examinations, the subcommittees will catalog all the items examined, with brief descriptions of each. This listing will accompany a report to the Ordnance Department covering such items as the W.E.B. group believes should furnish the basis for further development programs by the Ordnance Department. The listing will show, among other things, items of enemy superiority in design. This information will be available to manufacturers building automotive equipment to acquaint them with any unusual advantages possessed by the enemy materiel. Also it is possible that the Ordnance Department may wish to have additional laboratory research work conducted on certain specific parts and accessories.

The Steering Committee and the W.E.B. will correlate these proposed tests, notifying all manufacturers interested which laboratory is running equipment tests so all may share in the work and the data resulting therefrom.



Hosts of the SAE War Engineering Board chairmen of Technical Sub-Committees of the Captured Enemy Equipment Committee at Aberdeen Proving Ground, June 29, were (above, left to right) Col. George G. Eddy, director, Ordnance Research Center; Major-Gen. Charles T. Harris, Jr., commanding general of the Proving Ground; Col. J. H. Frye, chief, Research and Material Division, Research & Development Service, Ordnance Dept.; Capt. W. D. Barnes, Foreign Materiel Branch, Aberdeen Proving Ground, and Capt. W. S. Rigby, Development Division, Office of the Chief of Ordnance—Detroit

CHAIRMEN of the technical Subcommittees of the SAE War Engineering Board's Captured Enemy Equipment Committee giving one of captured German Panzer tanks the once-over at Aberdeen. (Above, left to right) L. A. Chaminade, Chevrolet Motor Division, and Harry Hawkins, Saginaw Steering Gear Division, General Motors Corp.; R. C. Sackett, SAE War Engineering Board secretary; C. R. Williams, Caterpillar Tractor Co.; Max M. Roensch, Chrysler Corp.; C. R. Boothby, Electric Auto-Lite Co.; R. L. Weider, White Motor Co.; W. J. McCortney and Tore Franzen, Chrysler Corp.; Oliver Kelley, Detroit Transmission Division, General Motors Corp.; R. P. Lewis, Spicer Mfg. Co., and Paul Huber, chairman of the group, Proving Ground Division, General Motors Corp.

SAE Coming Events

National Meetings

Tractor, ***Sept. 13-15, Schroeder Hotel, Milwaukee***

Aeronautic & Engineering Display, ***Oct. 5-7, Biltmore Hotel, Los Angeles***

Fuels & Lubricants, ***Nov. 9-10, Mayo Hotel, Tulsa***

Air Cargo, ***Dec. 4-6, Knickerbocker Hotel, Chicago***

Annual Meeting & Engineering Display, ***Jan. 8-12, 1945, Book-Cadillac Hotel, Detroit***

Aeronautic, ***April 4-6, 1945, Hotel New Yorker, New York***

Diesel F & L, ***May 16-17, 1945, Carter Hotel, Cleveland***

War Materiel, ***June 4 - 6, 1945, Book-Cadillac Hotel, Detroit***

Chicago – September 8 and 19

September 8 – Westward - Ho Country Club; dinner 7:00 p.m. SAE "Play-Day."

September 19 – Turner Hall, South Bend; dinner 6:45 p.m. Looking Ahead from Behind – G. W. Blair, manager, development, Footwear Division, U. S. Rubber Co.

Cleveland – Sept. 11

Cleveland Club; dinner 6:30 p.m. Enemy Material – Col. G. B. Jarrett, Aberdeen Proving Ground.

Colorado Group – September 18

Liberty Truck and Parts Co.; meeting 7:45 p.m. Plastics – E. K. Kruger, King Plastics Co., Denver. Motion picture.

Indiana – September 21

Antlers Hotel, Indianapolis; dinner 6:45 p.m. Automotive Engineering Horizons – W. S. James, chief engineer, Studebaker Corp., and president, SAE. Guest – John A. C. Warner, secretary and general manager, SAE.

Kansas City – September 11

Bellerive Hotel, dinner 6:30 p.m. Aircraft Materials in Light of War Developments – Henry J. Fischbeck, materials production engineer, Pratt & Whitney Aircraft, Div. United Aircraft Corp.

Metropolitan – September 14

Hotel Pennsylvania, New York; meeting 7:45 p.m. History and Development of Air Transport Command – Col. Harold R. Harris, assistant chief of Staff Plans, Army Air Forces, Air Transport Command, Washington, D. C.

Mid-Continent – October 6

Biltmore Hotel, Oklahoma City, meeting 7:30 p.m. Motor Vehicle Power Plants and Transmission Line Units – Robert Cass, chief engineer, White Motor Company.

Milwaukee – September 15

Westmoor Country Club; dinner 6:30 p.m. Annual Golf Meeting.

No. California – September 12

Aeronautics meeting. Speaker: W. H. Hanley, California Research Corp. Subject to be announced.

Northwest – September 8

Gorman Hotel, Seattle; dinner 7:00 p.m. Speaker and subject to be announced.

Peoria Group – September 25

Jefferson Hotel; dinner 6:30 p.m. Speaker and subject to be announced.

Southern Ohio – September 22

Van Cleve Hotel, Dayton; dinner 6:45 p.m. Automotive Engineering Horizons – W. S. James, chief engineer, Studebaker Corp., and president, SAE. Guest – John A. C. Warner, secretary and general manager, SAE.

Texas – September 15

Blackstone Hotel, Fort Worth; meeting 8:00 p.m. Bus and Trucks – Speaker to be announced.

Twin City Group – September 11

Curtis Hotel, Minneapolis; dinner 6:30 p.m. Automotive Engineering Horizons – W. S. James, chief engineer, Studebaker Corp., and president, SAE. Guest, John A. C. Warner, secretary and general manager, SAE.

Western Michigan – September 21

Occidental Hotel, Muskegon; meeting 7:30 p.m. Truck and Bus Engine Operation and Maintenance – W. A. Taussig, automotive engineer, Burlington Transportation Co.

Rambling Throug

George E. Hammel

PLAY-DAY golf outing sponsored by **CHICAGO SECTION** Sept. 8 at Westward-Ho Country Club will be a big event for automotive engineers and fleet men who will attend . . . Success is expected due to work of entertainment committee and its chairman, George E. Hammel, Studebaker Corp., who prepared many diverting features of day . . . Highlight will be award of over $1500 in War Bond prizes to golfers and door prize winners in addition to a variety of merchandise tokens . . . Program will include fun-making golf clowns, who will help to run up the laugh score on the green; Herb Graffis, noted humorist, golf commentator and newspaper columnist who will act as master of ceremonies; Billy Walsh's dance orchestra and a full course special dinner . . .

Nearly 600 members and their guests attended the **METROPOLITAN SECTION** smoker July 27 in the Hotel New Yorker, when Vice-Chairman R. Dixon Speas put on an evening program of combat films, an exhibit of captured enemy equipment with their U. S. prototypes, and refreshments . . . 1944-1945 Chairman Robert H. Clark made his first bow to the Section at the get-together, which was largely attended by Army and Navy personnel . . . A feature of the exhibit was a P&W Twin Wasp and a Japanese copy, the latter shot down in the South Pacific and shown through the courtesy of the Navy and the Pratt & Whitney Aircraft Division, United Aircraft Corp. . . .

Roster, complete with list of newly-elected Governing Board as well as Section members, released by **ST. LOUIS SECTION** . . . a handy supplement to its parent SAE Roster . . .

At a joint meeting of the San Diego Group of **SOUTHERN CALIFORNIA SECTION** and the San Diego Group of the Institute of Aeronautical Sciences July 20, J. Kenneth Salisbury, General Electric Co., talked on "The Gas Turbine – Its Characteristics and Potentialities" . . . Discussing the effects of temperatures, pressures and volumes on turbine efficiencies, Mr. Salisbury stated that the gas turbine, though widely publicized, is still in the experimental stage of development . . . Its virtues, he declared, are simplicity, compactness, light weight and the fact that it offers more potentialities as a coal burner than the diesel powerplant . . . Over 300 came to the meeting, which was presided over by the Section's San Diego vice-chairman, F. H. Sharp, Consolidated Vultee Aircraft Corp. . . .

Examining the cross section of a marine unit model of the gas turbine plant are, left to right: E. G. Stout, chairman of San Diego Group of Southern California Section; H. A. Cordes, General Electric Co.; B. B. Gravitt, General Electric Co.; F. H. Sharp, vice-chairman, San Diego Group of Southern California Section; and J. Kenneth Salisbury, General Electric Co.

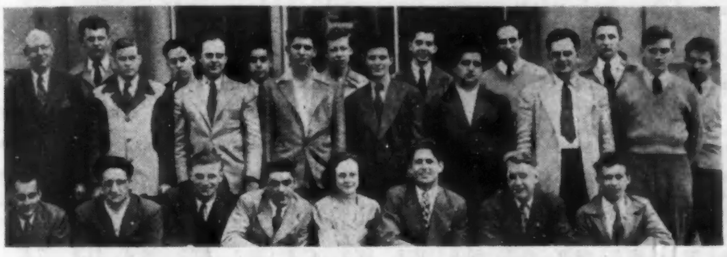
Section Reports

Variety of subjects will be offered at a series of monthly meetings scheduled during the next nine months by the **TEXAS SECTION,** which is spreading its topic assignments to cover fields outside of aviation . . . A blotter conveniently listing forthcoming season's meetings has been issued by Section, whose future activities are aiming at service for bus, air transport, fuels and lubricants, oil production, refining and plastics fields as well as aircraft . . .

First meeting of **WESTERN MICHIGAN SECTION** (formerly Muskegon Group) was held June 29, at which guest speaker W. T. Bean, Continental Aviation & Engineering Corp., discussed Experimental Stress Analysis of Engine Components . . . Explaining the static and dynamic methods of stress analysis, Mr. Bean emphasized the point that the stress analyzer's job is to study various parts of the engine in order to eliminate weight of the part and still keep dependability . . . supplemented talk with slides, photographs, and a display showing methods of stress analysis and parts which had been tested and improved by the process . . . Extra feature of evening was talk by T. M. Snyder, Continental Motors Corp., on the use of magnaflux in production . . .

Emil K. Harvey, American Export Airlines, Inc., fulfilled hopes of **CCNY SB** July 12 when he spoke about the Future of Commercial Aviation . . . Last year he talked of seaplane transports to the group, and students had been looking forward to his future discussions . . .

Despite the decrease in undergraduate enrollment at **DETROIT INSTITUTE OF TECHNOLOGY,** SAE Student Branch welcomed 19 new members during Spring semester . . . Six motion pictures pertaining to engineering were shown at this time, and four field trips to various industrial towns were arranged . . .



SAE enrolled students of Detroit Institute of Technology are: first row kneeling (left to right) Leo Chauvin, Vido Murgaski, Stanley Surowiak, William Shipitalo, Queenie Shirley, Walter Wikolaski, Roland Savage and Walter Mueller. Second row standing (left to right): Prof. Levi Henry, Frank Torode, Frank Bicsak, Nickolas Sasu, Walter Mykytyn, Kaloust Sogoian, Joseph Bicsak, Jr., and Henry Horldt. Third row standing (left to right): Leonard Ganchar, Edward Doyle, John Psihas, Harry Hoffmann, Fred Dietrich, Robert Rawlinson, Richard Filipp, and Donald Lowe

Group of 21 students and faculty members of **GENERAL MOTORS INSTITUTE** SB made factory trip through the Amphibious Duck Division of General Motors Truck & Coach Division June 28 . . . All impressed by highly-developed vehicles, among which was a boat carrying a three to four ton cargo able to take a 15 ft wave broadside, together with bilge pumps, propeller, rudder and other sea-going equipment . . . All these, together with gadgets to inflate and deflate tires on the vehicle while in motion, adds up to something the Japs would rather not know of . . .

SYNTHETIC Materials Require SAE Brake Hose REVISIONS

THE SAE General Standards Committee is being asked to approve revisions in the existing standards for air brake hose and for vacuum brake hose, following recent approval by its Non-Metallic Materials Division of the data developed by SAE-ASTM Technical Committee A. Similar revisions of the important hydraulic brake hose standard are currently being worked on by this joint group.

Generated by the necessity of replacing with synthetics the crude rubber commonly used for such hose when the SAE standard originally was approved in January, 1942, current changes in the specification relate chiefly to modification of swell and aging test procedures which are part of the standard. In addition, a cold test procedure has been inserted in connection with both air and vacuum hose.

In the case of the aging tests, the type of bar over which the hose shall be bent during the test now is specified. For air brake hose, a swell test procedure covering synthetic hose has been added, as follows:

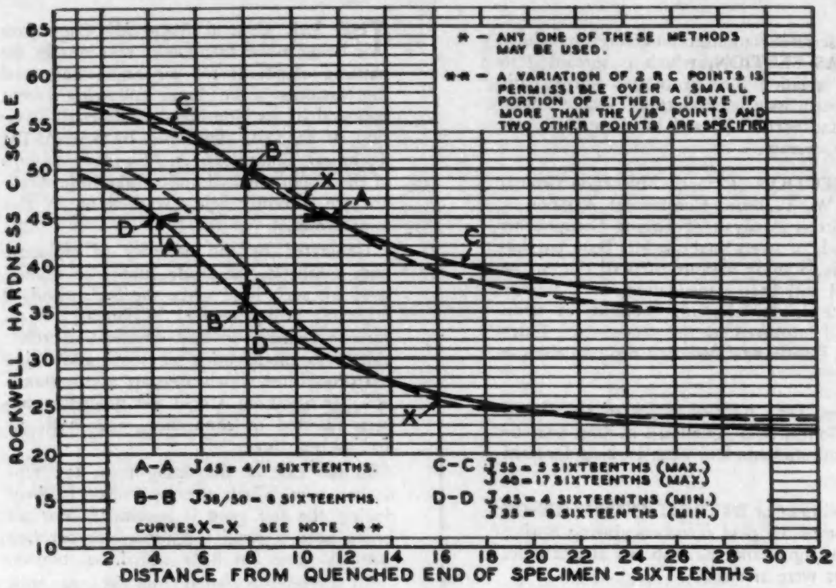
"A specimen prepared from the inner tube and from the cover of the hose shall show a volume increase when measured within 5 min after removal from ASTM precipitation naphtha in which it has been immersed for 24 hr at room temperature of not more than 35% for the inner tube and 50% for the cover."

Swell test procedure for vacuum hose will now involve use of ASTM precipitation naphtha instead of aviation gasoline and the pressure under which leakage may not be shown in vacuum test is reduced from 29 to 26 in. of mercury. The vacuum test itself also has been modified to require that: "The collapse of the outside diameter of the hose under internal vacuum of 26 in. of mercury for 5 min shall not exceed 1/16 in."

These modifications were agreed upon following the coordination of extensive test data developed by committee members over a long period of months. The tests were designed to learn as exactly as possible the service possibilities of synthetics as applied to air and vacuum hose to the end that the revised standards might be permitted synthetics to meet their requirements and at the same time insure adequate performance in service of hose which met the modified standard.

Members of the SAE Non-Metallic Materials Division meeting in Detroit July 13 to review recent work done on synthetic hose and tubing. Seated (left to right): H. A. Polderman, Caterpillar Tractor Co.; J. M. Gauss, Studebaker Corp.; Chairman W. M. Phillips, General Motors Research Laboratories Division; J. P. Wilson, Ford Motor Co., and Nicholas J. Rakas, Chrysler Corp. Standing (left to right): Lt. J. M. Forrest, Ordnance Department liaison; R. S. Burnett, SAE staff; Perry W. House, Delco-Remy Division, General Motors Corp.; J. Norman Miller, Glenn L. Martin Co., and G. O. McCarthy, Chrysler Corp.

AISI and SAE Develop NEW SPECIFICATIONS for Steels Based on COOPERATIVE Research Work on HARDENABILITY



■ Fig. 1 – Illustration of methods* of specifying requirements

A TENTATIVE uniform method for specifying fine-grain alloy steel, as reported in the August *SAE Journal*, has been developed cooperatively by the American Iron & Steel Institute and the Society of Automotive Engineers. Tables 1-3 are from the booklet describing the method and present maximum and minimum hardenability data for 37 steel analyses for use in specifications. Similar data for other steels will be released as soon as sufficient information is available. When steels are bought to hardenability specifications, the SAE, AISI, or NE number is followed by the letter "H," and somewhat broader chemical ranges apply.

It is recommended that for specification purposes two points be used to designate the desired hardenability. Four ways of doing this are illustrated in Fig. 1:

(1) The minimum and maximum distances at which any desired hardness value occurs (points *A-A*);

(2) the minimum and maximum hardness at any desired distances (points *B-B*);

(3) two maximum hardness values at two desired distances (points *C-C*); and

(4) two minimum hardness values at two desired distances, (points *D-D*).

In addition, any point on the minimum hardenability curve plus any point on the maximum curve may be specified. Where desirable, maximum and minimum limits at the 1/16 in. point may be included in addition to the two other points.

Table 1 – End-Quench Hardenability Bands – Tabulation of Band Limits for 4000 H

"J" Distance, in.	4130 H		4132 H		4135 H		4137 H		4140 H		4142 H		4145 H		4147 H		4150 H		4340 H		4620 H	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
1/16	54.0	46.5	55.5	48.0	57.0	50.0	58.5	51.5	60.0	52.5	62.0	54.0	63.0	55.0	64.0	56.5	65.0	58.0	60.0	52.5	48.0	40.5
1/8	54.0	45.0	55.0	46.0	57.0	49.0	58.5	50.0	60.0	52.0	62.0	53.5	63.0	54.5	64.0	56.5	65.0	58.0	60.0	52.5	46.0	31.0
1/4	52.0	39.0	53.5	40.5	56.5	46.0	58.0	47.5	60.0	50.0	61.0	52.0	62.0	53.0	63.5	55.0	65.0	57.0	60.0	52.5	39.0	22.0
3/8	48.0	34.0	50.0	36.0	54.5	42.0	56.5	44.0	59.0	47.0	60.5	49.0	61.5	51.0	63.0	53.5	64.5	55.0	60.0	52.5	33.0	19.0
1/2	43.5	30.0	46.5	32.0	52.0	38.0	55.0	40.0	58.5	43.5	60.0	45.5	61.0	48.0	62.5	51.0	64.0	53.0	60.0	52.0	29.5	....
5/8	40.0	27.5	43.0	29.5	49.5	34.0	53.0	36.5	57.0	40.0	59.0	42.5	60.0	45.0	62.0	47.5	63.5	50.0	60.0	51.5	27.5	....
3/4	37.5	26.0	40.5	28.0	47.5	31.0	51.0	33.5	56.0	37.0	58.0	39.5	59.5	42.0	61.0	44.5	63.0	47.0	60.0	51.0	26.0	....
7/8	35.0	24.5	39.0	26.0	45.5	29.5	49.5	32.0	55.0	35.0	57.0	37.5	59.0	39.5	61.0	42.0	63.0	44.0	60.0	50.5	25.0	....
1	33.5	23.0	37.5	25.0	44.0	28.5	48.0	30.5	54.0	34.0	56.0	36.0	58.0	38.0	60.0	40.0	62.0	42.0	60.0	50.0	24.5	....
1 1/4	31.5	21.0	35.5	23.0	42.0	27.5	46.5	29.0	52.0	32.0	54.5	34.0	57.0	35.5	59.0	37.0	61.0	39.0	60.0	48.0	23.0	....
1 1/2	30.5	20.0	34.5	21.5	41.0	26.5	45.5	28.5	51.0	31.0	53.0	32.5	55.5	34.0	58.0	35.5	60.0	37.0	60.0	46.0	22.5	....
1 3/4	30.0	....	34.0	20.5	40.0	26.0	44.5	28.0	50.0	30.0	52.5	31.5	54.5	33.0	57.0	34.5	59.0	36.0	60.0	44.5	22.0	....
2	29.5	....	34.0	20.0	39.5	25.5	44.0	27.0	49.0	29.0	51.5	31.0	53.5	32.5	55.5	33.5	58.0	35.5	60.0	43.0	22.0	....

Table 2 – End-Quench Hardenability Bands – Tabulation of Band Limits for 8600 H

"J" Distance in.	8620 H		8622 H		8625 H		8627 H		8630 H		8632 H		8635 H		8637 H		8640 H		8642 H		8645 H		8647 H		8650 H	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
1/16	48.0	40.5	49.5	42.0	50.5	43.5	52.5	45.5	54.0	46.5	55.5	48.0	57.0	49.5	58.5	51.5	60.0	52.5	62.0	54.0	63.0	55.0	64.0	56.5	65.0	58.0
1/8	46.5	32.0	48.0	35.0	50.0	38.0	51.5	42.0	54.0	45.0	55.5	47.0	57.0	48.0	58.5	50.5	60.0	51.5	62.0	53.0	63.0	54.0	64.0	56.0	65.0	57.0
1/4	41.0	24.0	43.5	27.5	46.5	31.0	49.0	35.0	52.0	39.0	54.0	42.0	56.0	44.5	57.5	47.0	59.0	48.5	61.0	50.5	62.5	52.0	64.0	53.5	65.0	55.0
3/8	34.5	21.0	38.0	24.0	41.0	27.0	44.5	30.0	48.0	33.0	50.5	35.5	53.0	38.0	55.0	40.5	57.0	43.0	59.0	46.0	61.0	48.0	62.5	50.0	63.5	52.0
1/2	31.0	....	34.0	21.0	37.0	24.0	40.0	26.5	42.5	29.0	45.5	31.0	48.0	33.5	51.0	36.0	53.0	38.0	56.0	40.5	58.0	43.0	60.5	45.5	62.0	48.0
5/8	28.5	....	31.0	....	34.0	21.5	36.5	24.0	39.0	26.0	42.0	28.0	44.5	30.0	47.0	32.0	49.5	34.0	52.0	36.5	55.0	39.0	57.5	41.5	60.0	44.5
3/4	27.0	....	29.0	....	32.0	....	34.0	22.0	36.5	24.5	39.0	26.0	42.0	27.5	44.0	29.5	47.0	31.0	50.0	33.5	52.5	36.0	55.0	38.5	58.0	41.0
7/8	25.5	....	28.0	....	30.0	....	32.0	20.5	34.5	23.0	37.0	24.5	39.5	26.0	42.0	27.5	44.5	29.0	48.0	31.0	50.5	33.0	53.0	35.5	56.0	38.0
1	25.0	....	27.0	....	29.0	....	31.0	....	33.0	22.0	35.5	23.0	38.0	24.5	40.0	26.0	43.0	27.5	46.0	29.5	48.5	31.0	51.5	33.5	54.0	35.5
1 1/4	23.5	....	25.5	....	27.5	....	29.0	....	31.0	20.0	33.5	21.5	36.0	23.0	38.0	24.0	40.5	25.5	43.0	27.5	46.0	29.0	48.5	31.0	51.0	32.5
1 1/2	22.5	....	24.5	....	26.0	....	28.0	....	30.0	....	32.5	20.5	34.5	22.0	36.5	23.5	39.0	25.0	41.5	26.0	44.0	28.0	46.5	29.0	49.0	31.0
1 3/4	22.0	....	24.0	....	26.0	....	27.5	....	29.5	....	32.0	20.0	33.5	21.5	35.5	23.0	37.5	24.5	40.0	25.5	42.5	27.5	45.0	28.5	47.0	30.0
2	22.0	....	24.0	....	25.5	....	27.5	....	29.0	....	31.5	....	33.0	21.0	35.0	22.5	37.0	24.0	39.0	25.5	41.5	27.0	43.5	28.0	46.0	29.5

Table 3 – End-Quench Hardenability Bands – Tabulation of Band Limits for 8700 H

"J" Distance, in.	8720 H		8722 H		8725 H		8727 H		8730 H		8732 H		8735 H		8737 H		8740 H		8742 H		8745 H		8747 H		8750 H	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
1/16	48.0	40.5	49.5	42.0	50.5	43.5	52.5	45.5	54.0	46.5	55.5	48.0	57.0	49.5	58.5	51.5	60.0	52.5	62.0	54.0	63.0	55.0	64.0	56.5	65.0	58.0
1/8	46.5	36.0	48.0	38.5	50.0	40.5	52.0	43.0	54.0	45.0	55.5	47.0	57.0	48.5	58.5	50.5	60.0	52.0	62.0	53.5	63.0	55.0	64.0	56.5	65.0	57.5
1/4	42.0	25.5	44.0	28.5	47.0	32.5	49.5	35.0	52.5	40.5	54.5	43.0	56.0	46.0	57.5	48.0	59.5	49.5	61.0	51.5	62.5	53.5	64.0	54.5	65.0	56.5
3/8	36.0	22.0	39.0	24.5	42.5	28.0	46.0	30.0	49.0	34.5	51.5	37.5	53.5	41.0	55.5	43.0	57.5	45.0	59.0	48.0	61.0	50.0	63.0	52.0	65.0	55.0
1/2	33.0	20.5	35.5	22.5	38.5	25.5	42.0	26.5	45.0	30.5	47.5	33.0	50.0	36.0	52.5	38.0	55.0	40.0	57.0	43.0	59.5	45.5	62.0	48.0	64.0	51.0
5/8	30.0	....	33.0	20.5	36.0	23.0	39.0	23.5	41.5	27.0	44.0	30.0	47.0	32.0	49.5	34.0	52.5	36.0	55.0	39.0	58.0	42.0	60.5	44.0	63.0	47.0
3/4	28.5	....	31.0	....	34.0	20.5	36.0	22.5	39.0	25.0	42.0	28.0	44.5	29.5	47.0	31.0	50.0	33.0	53.0	36.0	56.0	39.0	59.0	41.0	62.0	43.5
7/8	27.5	....	29.5	....	32.0	....	35.0	21.0	37.0	24.0	39.5	26.0	42.5	27.5	45.0	29.0	48.0	31.0	51.0	34.0	54.5	36.0	57.5	38.5	61.0	40.5
1	26.5	....	28.5	....	31.0	....	33.0	20.0	35.5	23.0	38.0	25.0	41.0	26.5	43.5	28.0	46.0	29.0	49.0	32.0	52.5	34.0	56.5	36.5	60.0	38.5
1 1/4	25.0	....	27.0	....	29.5	....	31.5	....	33.5	22.0	36.0	23.0	38.5	25.0	41.0	26.0	43.0	27.5	47.0	29.5	50.0	31.5	54.0	33.5	57.5	35.0
1 1/2	24.0	....	26.5	....	28.5	....	30.5	....	32.5	21.0	35.0	22.0	37.5	23.5	39.5	25.0	42.0	26.5	45.5	28.0	48.5	30.0	52.5	32.0	55.5	33.5
1 3/4	23.5	....	26.0	....	28.0	....	30.0	....	32.0	20.0	34.0	21.5	36.5	23.0	39.0	24.5	41.0	26.0	44.5	28.0	47.5	29.5	51.0	31.0	54.5	32.5
2	23.5	....	26.0	....	28.0	....	30.0	....	32.0	....	34.0	21.5	36.0	22.5	38.5	24.0	40.0	25.5	44.0	28.0	47.0	29.5	50.0	31.0	53.5	32.5

PROJECT CHAIRMEN MEET WITH T & M SPONSORING COMMITTEE

Initial meeting of Sponsoring Committee and project chairmen of T&M 1944 Work Program was held in July during the SAE National Transportation & Maintenance Meeting at Philadelphia. Seated (left to right) are: W. R. Herfurth, R. H. Macy & Co.; John J. Powelson, Standard Oil Co. of N. J.; Fred H. Purdy, Canada Dry Ginger Ale, Inc.; SAE Vice-President Ellis W. Templin; Charles M. Hudson, Tennessee Valley Authority; S. G. Page, Equitable Auto Co.; W. J. Cumming, Office of Defense Transportation; Howard R. Grigsby, Oklahoma Gas & Electric Co.; and G. M. Sprowls, Goodyear Tire & Rubber Co. Standing (left to right): J. Verne Savage, City of Portland; Robert Gardner, Lever Bros. Co.; Emil H. Piron, Transit Research Corp.; Clarence S. Bruce, National Bureau of Standards; R. Lyle Brace, Brace Engineering Co.; George H. Scragg, White Motor Co.; R. H. Dalgleish, Philadelphia Transportation Co.; Jean Y. Ray, Virginia Power & Electric Co.; J. F. Winchester, Standard Oil Co. of N. J.; E. N. Hatch, N. Y. Transit System; J. P. Stewart, Socony-Vacuum Oil Co., Inc.; and Henry Jennings, SAE Staff

T & M

1944 Work Program Swings into Action

ORGANIZATION has been completed of a majority of the project committees engaged in the 1944 T&M Work Program developed under the leadership of SAE Vice-President Ellis W. Templin and operated through a Sponsoring Committee headed by Robert E. Rowley. Active progress already has been made on a number of the projects in this new program which covers areas not touched upon by the T&M war program. Vice-President Templin is eager to have additional names of qualified T&M men who might be available for work on sub-groups in this important effort.

Psychology underlying the new program aptly has been stated by Vice-President Templin as follows:

"To keep motor vehicle transportation at high efficiency, we must find the answers to our several problems. Time has proved that the best and quickest way to get the solution of an automotive problem is to assign it to an SAE committee. Now that we are well along on the SAE-ODT program, it seems only fitting that we do something for ourselves in the interest of carrying transportation over the hump. That is what we are doing in the 1944 T&M Work Program."

Problems are Complicated

The new program recognizes, not only that fleet problems are serious to the point of multiplying the aggravation by the x which represents the number of vehicles involved, but also that geographical distribution of human experience is a highly important factor in compiling data. The first thought suggests that a 5% error can be tremendously expensive in the case of a motor vehicle fleet; the second that different operating conditions and experiences in various sections of the country contribute greatly to comprehensive knowledge.

As developed, the 1944 T&M Work Program establishes six project groups responsible for developing basic engineering data on fleet management, maintenance control and research, equipment and design factors, human engineering, and engineering problems peculiar to specialized equipment. More than 40 separate projects are contemplated under the direction of the Sponsoring Committee of which Robert E. Rowley is chairman. The chairmen of the project groups, who are sponsors of the projects and members of the Sponsoring Committee are: Fleet Management, J. F. Winchester; Maintenance Control and Research, Charles Hudson; Equipment and Design Factors, S. G. Page; Human Engineering, Harley Drake; Public Utility Vehicles, H. R. Grigsby; and Bus Problems, E. H. Piron. Other members of the Sponsoring Committee are: Jean Y. Ray and Austin M. Wolf.

To Compile Data

Promotion of projects calls upon the maintenance control and research group to compile engineering data on prevention and removal of engine deposits, preventive maintenance and inspection procedures, shop layout and equipment, and methods, materials, and equipment for lubrication. The group concerned with fleet management problems is to study development of standard specification forms for the purchase of vehicles, equipment and supplies; retirement and renewal programs; accounting and cost analysis; and material handling. Current work involves the compilation of established practices of leading fleet operators.

Relative merits of "gadgets," engine temperature control, design elements affecting safety, and interchangeability of batteries and carriers are among subjects suggested for consideration by the group interested in equipment and design factors. In the project on public utility vehicles are problems such as transportation of heavy transformers, and power take-off driven equipment. The bus project covers, among other subjects, transmission and clutch systems, performance testing, and brake maintenance related to live loads. Human engineering problems include training of drivers, mechanics, and other personnel.

T&M WAR PROJECTS Move Ahead Steadily

WAR projects going forward under the SAE T&M War Advisory Committee developed continued momentum in recent weeks as both the Ordnance Vehicle Maintenance Committee and the ODT Coordinating Committee pushed current projects toward completion.

Army Submits Questions

Particularly active has been one OVMC project under the chairmanship of Austin Wolf working on "Limits and Tolerances for the Replacement of Parts and Units." Roy C. Penrod of the Ordnance Department, acting as liaison with this group, has recently completed a tour of Army Base shops developing a list of questions regarding such limits most frequently asked by officers charged with vehicle overhaul. Mr. Wolf's group is now engaged in answering those questions in terms of commercial fleet experience. The work will proceed on a step by step basis and seems likely to continue, following completion of reports on the more immediate questions posed by Ordnance through Mr. Penrod.

Earlier Projects Continue

Continuing its active test program, a Brake Drum group, under the chairmanship of John V. Bassett, working under the OVMC Subcommittee on Reclamation of Parts, recently has put more brake drums into heavy duty service and is accumulating performance results steadily. The Engine Valve Group, headed by Norman Hoertz, functioning under this same OVMC subcommittee, is accumulating mileage on test samples in the hands of cooperating fleet operators and expects to be ready with a final report some time this month.

The SAE-ODT report on Welding in Maintenance, prepared by a subcommittee under the chairmanship of E. C. Wood, has been completed and submitted to the Office of Defense Transportation.

Land Wins Vice-Admiralcy

Vice-Admiral Emory S. Land, chairman of the U. S. Maritime Commission and the War Shipping Administration, third from the left, receiving his commission from Secretary James Forrestal of the Navy as "Naval constructor in the Navy with the rank of Vice-Admiral," at a brief ceremony in the Secretary's office July 14. The admiral served as chairman of the SAE Aircraft Engine Subdivision in 1928-29 when a captain. At the left is Mrs. Land and Undersecretary of the Navy Ralph A. Bard is at the right. The commission required a special act of Congress

About

JOHN R. COX, formerly vice-president of Weatherhead Co., Cleveland, is now connected with Balas Collet Mfg. Co., same city, as managing partner. He is the newly-elected treasurer of the SAE Cleveland Section.

Previously junior test engineer for Wright Aeronautical Corp., Paterson, N. J., **ALLAN E. PARK** may now be reached at the National Advisory Committee for Aeronautics, Cleveland.

JACOB H. MEYER, who had been service engineer for Pacific Inland Transport Co., Portland, Ore., is now with Pointer Willamette Co., same city, as a machinist.

EDWARD U. BLANCHARD has been appointed chief metallurgist of Tyson Roller Bearing Corp., Massillon, Ohio. He had been employed by Bower Roller Bearing Co., Detroit, in the same capacity.

ROBERT H. BONNEY, formerly layout draftsman for Caterpillar Tractor Co., Peoria, Ill., is now in the U. S. Navy, stationed at the Great Lakes Naval Training Center, Ill.

DONALD V. BARKER is no longer special representative of the National Accounts Division of Studebaker Corp., South Bend, Ind., having recently joined the Fargo Division of Chrysler Corp.

JOHN L. HOOVEN, who as a civilian was junior designer for Ford Motor Co., Rouge Plant, Dearborn, Mich., is now in the U. S. Navy. He may be reached at Company 1424, U. S. Naval Training Station, Great Lakes, Ill.

MARTIN R. RASPET, USMC, who was formerly stationed at Camp Pendleton. Oceanside, Calif., may now be contacted c/o Fleet Post Office, San Francisco.

E. E. LeVAN has been elected president of Haynes Stellite Co., Kokomo, Ind., a unit of Union Carbide & Carbon Corp. He joined the company in 1922 as sales manager, and became successively chief engineer, general sales manager, vice-president and general manager.

E. E. LeVan

WILLIAM ARMSTRONG is in charge of planning and control for Simmonds Aerocessories Inc., Long Island City, N. Y., and is also director and vice-president of Dowty Equipment (Canada) Ltd. He was formerly vice-president of engineering for Hub Industries, Inc., Long Island City, N. Y.

ENSIGN A. L. MERCER, JR., USNR, is now at the Naval Ammunition Depot, St. Julien's Creek, Portsmouth, Va. In civilian life he was vice-president of the Cleveland Tractor Co., Cleveland.

M. DWIGHT PEARCE, JR., formerly production engineer for Smith, Hinchman & Grylls, Inc., Detroit, is now with S & S Tool & Mfg. Co., same city, as production engineer and purchasing agent.

WALLACE J. LATCHEM, who had been design engineer for Noorduyn Aviation, Ltd., Quebec, Canada, is now powerplant engineer for Trans Canada Air Lines, same city.

Post-office address of **LT. EDWIN D. THOMPSON,** U. S. Army, has been changed from A.P.O. 600 to A.P.O. 667, New York City.

ROBERT J. PATTERSON has recently joined Turbo Engineering Corp., Trenton, N. J., as director of training.

Formerly senior layout draftsman for Emerson Electric Mfg. Co., St. Louis, Mo., **R. E. ROOT** is now in the U. S. Army Air Forces, and may be reached at Buckley Field, Colo.

C. R. TALMAGE, who had been connected with Manning-Bowman Co., Meriden, Conn., is now an engineer in charge of analytical surveys for the Smaller War Plants Corp., New Haven, Conn.

HOWARD R. NIGGLES is now in the U. S. Navy as first class petty officer, motor machinist mate, stationed at the Philadelphia Navy Yard. He had been principal instructor for the U. S. Army at the Holabird Ordnance Base, Baltimore.

DOUGLAS R. COWDREY, a former student at General Motors Institute, is now in the U. S. Army, and may be contacted at Camp Wheeler, Ga.

RICHARD B. GERSTEN, formerly a student at Ohio State University, is now in the U. S. Army, stationed at Company A, 34th Battalion, Camp Grant, Ill.

C. E. BRAZEAL, JR., a former student of Ohio State University, is now in a special engineering detachment of the U. S. Army at Oak Ridge, Tenn.

WALTER W. ROGERS, who had been sales engineer for Muskegon Piston Ring Co., Muskegon, Mich., is now a manufacturers' agent in Detroit.

SHERROD E. SKINNER, general manager of Oldsmobile Division and vice-president of General Motors Corp., has been unanimously elected a life trustee of Rensselaer Polytechnic Institute. He is an alumnus of the Institute, having graduated in 1920.

SAE Members ...

LT. JAMES P. McSWEENEY, who had been at Camp San Luis Obispo, Calif., may now be reached at A.P.O. 5799, c/o Postmaster, San Francisco.

ROY G. LaGRANT is now an ensign, USNR, in the Production Division of Puget Sound Navy Yard, Bremerton, Wash. As a civilian he was aircraft inspector for Briggs Mfg. Co., c/o Boeing Aircraft Co., Detroit.

LT. CHARLES H. MARTENS, USNR, has been transferred from the Bureau of Aeronautics, Navy Department, Washington, to the Naval Aviation Supply Depot, Philadelphia.

DAVID R. JONES, formerly engineering assistant at Factory A, Lockheed Aircraft Corp., Burbank, Calif., is now in the U. S. Army Air Forces, and may be reached at the Powerplant Research Branch, Materiel Command Flight Test Base, Muroc, Calif.

MAJOR KENNETH L. STEHLE'S A.P.O. address has been changed from 914 to 953, c/o Postmaster, San Francisco.

Previously chief chemist for D-A Lubricant Co., Inc., Indianapolis, **JOHN WADE NEWCOMBE** is now connected with Monsanto Chemical Co., St. Louis, Mo., as technical representative in the petroleum chemical department.

ARTHUR TOWNHILL, formerly castings engineer for Thompson Products, Inc., Cleveland, has been named manager of the new Light Metals Division of the company,

Arthur Townhill

which has full control of all foundry operations. Mr. Townhill is past-chairman of the SAE Cleveland Section.

Formerly engineering assistant at Lockheed Aircraft Corp., Burbank, Calif., **LEONARD G. MAZEL** is now at the U. S. Naval Training Center, Great Lakes, Ill.

WILBUR R. VESTER, U. S. Army, has been transferred from Camp McCoy, Wis., to Fort Benning, Ga.

Frederick W. Mesinger (above), has been elected vice-president of Norma-Hoffmann Bearings Corp., Stamford, Conn., succeeding Harold J. Ritter. Mr. Mesinger, a past vice-chairman of the SAE Southern New England Section, has been with Norma-Hoffmann more than 24 years, and was New York district manager for the past 16 years

ROBERT J. LUNN, U. S. Army, may be reached at Company B, Barracks 235, Rossford Ordnance Depot, Toledo, Ohio. He was formerly field engineer for Donaldson Co., Inc., St. Paul, Minn.

SAUL S. FRECHTEL, a former student of the College of the City of New York, is now in the U. S. Army stationed at Camp Blanding, Fla.

ROLAND W. STEPHENSON, U. S. Navy, has been transferred from the General Ordnance School in Washington to the U. S. Naval Air Station, Jacksonville, Fla.

O. A. RADERMACHER, civilian automotive adviser for the U. S. Army, has moved from the Ordnance Section, Camp Campbell, Ky., to Headquarters 415th Field Artillery Group, Camp Forrest, Tenn.

GEORGE P. NELSON has left Precision Spring Corp., Detroit, where he was factory manager, to return to L. A. Young Spring & Wire Corp., same city, as director of engineering covering the 11 plants located in the United States and Canada.

Previously technical assistant to the general manager of the Aircraft & Engine Division, Embry-Riddle Co., Miami, Fla., **C. F. GRAFFLIN** is now engine specialist for Dade Drydock Corp., same city.

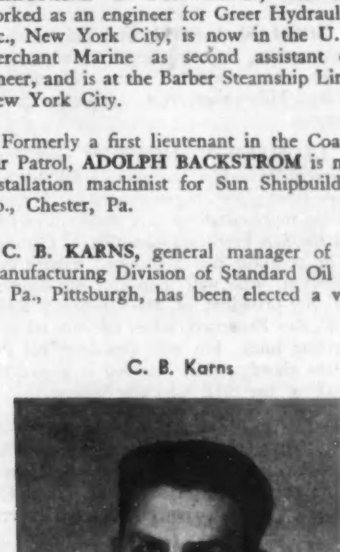
SILAS CARR SNYDER, formerly sales engineer for Continental Motors Corp., Detroit, has joined American Aircraft Mfg. Co., Dayton, Ohio, as manager of the Engine-Generator Division.

LEONARD L. MAITLAND, who had worked as an engineer for Greer Hydraulics, Inc., New York City, is now in the U. S. Merchant Marine as second assistant engineer, and is at the Barber Steamship Lines, New York City.

Formerly a first lieutenant in the Coastal Air Patrol, **ADOLPH BACKSTROM** is now installation machinist for Sun Shipbuilding Co., Chester, Pa.

C. B. KARNS, general manager of the Manufacturing Division of Standard Oil Co. of Pa., Pittsburgh, has been elected a vice-

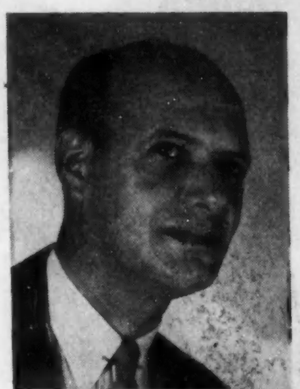
C. B. Karns



president of the company. He was formerly vice-president of Penola, Inc., same city.

EDWARD GRABOW, JR., previously product planning engineer for Link Aviation Devices, Inc., Hillcrest, N. Y., is now in the Army Air Forces, stationed at Lowry Field, Denver, Colo.

New streamlined methods for overhauling aircraft and aviation engines have been installed and proved practical by the U. S. Navy, according to **BENJAMIN B.**



Benjamin B. Cravens

CRAVENS. Heading a group of engineers for Corrigan, Osburne & Wells, Inc., New York City, Mr. Cravens has spent the past few months analyzing aircraft and radial engine overhaul methods and requirements.

GEORGE THARRATT, formerly chief engineer of Adel Precision Products Corp., Burbank, Calif., is now general manager of Lear Avia, Inc., Los Angeles. Mr. Tharratt is chairman of the SAE Southern California Section.

MICHAEL J. ROSS, who had been in the engineering department of Crane Co., Chicago, has recently joined Harnischfeger Corp., Milwaukee, Wis., as mechanical engineer.

LEONARD V. NEWTON was recently presented with a sheepskin scroll by nearly two-score civic organizations and Government representatives in a goodwill ceremony at the San Francisco Chamber of Commerce. The occasion was a farewell tribute to Mr. Newton, who will soon end his connection as vice-president of Market Street Railway Co., San Francisco, when the city takes over private lines. He will announce his future plans shortly. Mr. Newton is a past-chairman of the SAE Chicago Section.

LT. (jg) V. C. REDDY, E-V(S), USNR, may be reached at the Naval Supply Depot, Mechanicsburg, Pa. In private life he had been assistant to the director, Detroit Diesel Engine Division, General Motors Corp.

G. M. BELLANCA, previously consulting aeronautical engineer and designer for Higgins Industries, Inc., New Orleans, La., is now chairman of the board of directors of Bellanca Aircraft Corp., New Castle, Del.

THOMAS F. BRUDENELL, who had been assistant design engineer for Caterpillar Military Engine Co., Decatur, Ill., has joined Atlas Imperial Diesel Engine Co., Chicago, as an engineer.

Formerly a draftsman at Allis-Chalmers Mfg. Co., Milwaukee, **REYNOLD ANDERSON** is now in the U. S. Navy, and is at the Naval Training Station at Hollywood, Fla.

BRUCE C. BENEDICT has recently changed his business connections from the research department of Lion Oil Refining Co., El Dorado, Ark., where he was research engineer, to the research department of Phillips Petroleum Co., Bartlesville, Okla., where he is a chemical engineer.

JOHN F. CREAMER, chairman of the board of Wheels, Inc., and one of the founders of the National Wheel & Rim Association, has been elected a member of the Board of Trustees of the Automotive Safety Foundation as the association's representative. Chairman of Metropolitan Section in 1932, Mr. Creamer has been active as a member of numerous SAE committees. He served as a member of the New York Board of Education Automotive Educational Committee and devoted a great deal of energy in the planning of the $3,000,000 Brooklyn High School of Automotive Trades. An artillery officer in World War I, Mr. Creamer spent more than two years as adviser and associate director of procurement, Motor Transport Division, Quartermaster Corps, and later with the Navy in a similar capacity.

COM. A. L. BAIRD, USN, has been transferred from the Bureau of Aeronautics, Navy Department, Washington, D. C., and may now be reached c/o Fleet Post Office, San Francisco.

ELMER F. DE TIERE, JR., an ensign in the U. S. Navy, may be contacted c/o Fleet Post Office, San Francisco. He had been at the U. S. Naval Air Station, Norfolk, Va.

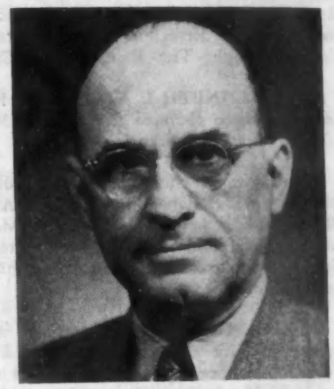
FRANK A. GUNDLACH is a first lieutenant in the U. S. Army Ordnance Department, Maintenance Division, Parts Requirements Branch, Office of the Chief of Ordnance-Detroit. He was formerly technical supervisor for National Carbon Co., Inc., New York City.

F. MALCOLM REID, vice-president in charge of engineering of Fruehauf Trailer Co., Detroit, has been elected a director of the organization. Mr. Reid has been in charge of Fruehauf engineering for the past 22 years.

Flight Officer **JOSEPH G. ROSE III** has been transferred from the 63rd Troop Carrier Group, Sedalia Army Air Base, Knobnoster, Mo., to Section B, Office of Engineering Officer, Warrensburg, Mo.

LT.-GEN. WILLIAM S. KNUDSEN, formerly director of production of the Army Service Forces, has been appointed director of Army Air Forces Materiel and Services, reporting to Major-Gen. Oliver P. Echols, assistant chief of Air Staff, Materiel & Services, Headquarters, AAF. General Knudsen's assistant will be Major-Gen. Bennett E. Meyers, deputy director, and has been transferred to Patterson Field, Fairfield, Ohio. Major-Gen. Delmar H. Dunton is commanding general, AAF Air Service Command, taking the post formerly occupied by Major-Gen. Walter H. Frank. Brig.-Gen. Kenneth B. Wolfe is now commanding general of the AAF Materiel Command, relieving Major-Gen. Charles E. Branshaw. The merger of the Materiel and Air Service Commands under General Echols was said by Army spokesmen to be a move toward closer integration of the design and manufacturing functions of the AAF with its maintenance engineering.

FRED B. LAUTZENHISER has severed his connection as consulting automotive engineer with the War Production Board, and is returning to International Harvester Co., Chicago, as consulting engineer. He joined



Fred B. Lautzenhiser

the Office of Production Management, later succeeded by WPB, in 1941. Mr. Lautzenhiser, a past vice-chairman of the T&M Engineering Activity, is now a member of the Truck & Bus Engineering Activity Committee.

MILO M. DEAN, who had been executive engineer for Douglas Aircraft Co., Inc., Santa Monica, Calif., is now chief engineer for Greyhound Corp., Chicago.

The 160 millionth aircraft fitting produced by the Weatherhead Co., Cleveland, in the 135 weeks since Pearl Harbor is examined by A. J. Weatherhead, Jr., president, (right) and H. C. Ferguson (left), manager of the company's New York sales office

Joseph Perrin

JOSEPH **PERRIN,** who had been with Simmonds Aerocessories. Inc., Long Island City, N. Y., as aircraft hydraulic engineer, is now assistant chief engineer for Greer Hydraulics, Inc., New York City.

EDWIN K. SMITH, who is with the Science, Education & Art Division, China Section of the Department of State, Washington, has, at the request of the Chinese Government, been appointed to go to China as a metallurgical specialist to serve with the Chinese National Resources Commission. He was formerly a major in the U. S. Army Ordnance Department.

GUY E. FINOUT, JR., who had been a sergeant in the U. S. Army, has returned to his former civilian position as draftsman for the Fisher Body Division, Plant No. 1, GMC, Flint, Mich.

C. O. MONROE, U. S. Navy, has been transferred from (AA) Platoon 97, Area El, Camp Peary, Va., to active service, where he may be reached c/o Fleet Post Office, San Francisco, Calif.

ROBERT J. SWIFKA, previously connected with Austin Co., Midland, Mich., is now with Buick Motors Division, GMC, Flint, Mich.

LT. GEORGE T. HAYES, U. S. Navy, may now be contacted c/o Fleet Post Office, San Francisco, Calif. He was formerly at the Naval Air Station, Alameda, Calif.

ETHAN ALLEN BERRY has joined Columbia Machine Works, Inc., Brooklyn, N. Y., as works manager. He was formerly chief engineer for Empire Ordnance Corp., Philadelphia.

HUGH S. CAMERON has left Pratt Institute, Brooklyn, N. Y., as associate professor of mechanical engineering to become connected with the mechanical engineering department of Rice Institute, Houston, Tex.

Previously a mechanical engineer for Watson-Flagg Machine Co., Inc., Paterson, N. J., **ABBOT A. LANE** is now director of engineering for Edward Ermold Co., New York City.

Formerly chief engineer for Clark Ruse Aircraft, Ltd., Moncton, New Brunswick, Canada, **JOSEPH RZECZYCKI** is now in the tool and process engineering department of Fairchild Aircraft, Ltd., Longueuil, Que.

RICHARD H. OWENS is now employed as a project engineer on development work for Jack & Heintz, Inc., Bedford, Ohio. He had been chief model test engineer for Dodge Chicago Plant, Chrysler Corp., Chicago.

NEWELL HOYT McCUEN, previously inspecting foreman of Cadillac Motor Car Division, General Motors Corp., Detroit, is now in the U. S. Navy, stationed at the Great Lakes Naval Training Center, Ill.

LT. ROBERT L. DOUGLAS may be reached at Headquarters, 548th Anti-Aircraft Artillery AW Battalion, Camp Haan, Calif. He had been in the 772nd AAA Gun Battalion, same camp.

ROGER BURLEY has joined Federal Motor Truck Co., Detroit, as assistant to the president. He was formerly secretary and sales manager for Available Truck Co., Chicago.

LT.-COL. WALTER C. THEE, who is serving overseas, has been moved from A.P.O. 962 to A.P.O. 957, c/o Postmaster, San Francisco.

RALPH E. CARLSON, lieutenant (jg) USNR, may be reached at the U. S. Naval Academy, Annapolis, Md. His former address was Navy 135, Fleet Post Office, San Francisco.

KARL O. BOTNEN, U. S. Army, has been transferred from A.P.O. 15258 to A.P.O. 716, c/o Postmaster, San Francisco.

C. T. S. CAPEL, who had been an aeronautical technician in Capetown, South Africa, is now in the same country doing consulting and production engineering work in Johannesburg.

LT. LOUIS A. EDELMAN has been moved from Colorado Springs, Colo. to Administrative Section A, Army Air Forces, Ardmore, Okla.

ROBERT J. JOBIN, JR., U. S. Navy, is stationed at the U. S. Naval Air Station, Quonset Point, R. I. He had been a technician for the U. S. Department of Agriculture, Washington.

F. T. TURNER has been promoted to assistant sales manager of the Brush Division of Osborn Mfg. Co., Cleveland. He was formerly in charge of technical sales research for the company.

F. T. Turner

John S. Naery

JOHN S. NAERY, assistant vice-president in charge of production for J. I. Case Co., Racine, Wis., has been named by Brig.-Gen. E. R. Hardy, Office of Chief of Ordnance, War Department, to serve as assistant chairman of ordnance, department of industry integration committee, to produce 155 mm shells in 56 war plants throughout the United States.

T. R. N. WHYTE is labor and welfare officer for the British Ministry of Supply, where he is connected with ordnance factory personnel. He had been with the Petroleum Board, Shell-Mex House, London, in an administrative capacity.

JOSEPH H. SCHROEDER, assistant to the chief engineer of Barlow-Seelig Mfg. Co., Ripon, Wis., has been named secretary and treasurer of Dauber Co., Oshkosh, Wis.

Previously chief engineer for Fisk Airplane & Engine Co., Mission San Jose, Calif., **EDWIN M. FISK** is now engineer in charge of diesel development for Reed Mfg. Co., Los Angeles.

A resolution has recently been presented to **RAY SANDERS** by members of the Los Angeles Automotive Council in commemoration of his retirement as president of the organization. The resolution is an expression of the appreciation of the outstanding job he has done for the Council. Mr. Sanders, who is vice-chairman of Transportation & Maintenance for the SAE Southern California Section, is vice-president and general sales manager of Turco Products Co., Los Angeles.

WILLIAM ROSS BAKER, a former student of the University of Wisconsin, is now in the U. S. Navy stationed at the Naval Training Center, Great Lakes, Ill.

MAJOR ROBERT C. HALL, U. S. Army, has been transferred from Camp Lee, Va., to overseas service, where he may be reached at A. P. O. 582, c/o Postmaster, New York City. Major Hall is a past-chairman of the SAE Baltimore Section.

Having severed his connection with Graham Paige Motor Corp., **WALTER SCOTT HOOVER** is continuing his activities as consulting engineer in aircraft propellers for the Canadian Car & Foundry Co., Ltd., in Montreal, Canada. Mr. Hoover has been asso-

ciated with the Canadian organization since 1938.

H. L. FREEMAN, civilian automotive adviser in the U. S. Army, has been transferred from Camp Gordon, Ga., to the Automotive Section, Camp Haan, Calif.

LT.-COL. ROBERT E. JEFFREY, JR., recently promoted to his present rank, has been assigned overseas by the Ordnance Department. He was an engineer for the Shell Oil Co., Inc., and entered the Army before Pearl Harbor as a first lieutenant.

Formerly employed by Ranger Aircraft Engines, Division Fairchild Engine & Airplane Corp., Farmingdale, L. I., N. Y., as divisional representative on the Pacific Coast, **FRANK D. ST. HILAIRE** is now technical representative for Wright Aeronautical Corp., Paterson, N. J.

JOHN E. DEVEREAUX is now an engineer for Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. He had been project engineer for the Naval Ordnance Plant at Centerline, Mich.

The twelfth edition of **P. M. HELDT'S** series on "The Gasoline Motor," entitled "High-Speed Combustion Engines," has a completely revised text. A considerable amount of new material has been added, as in chapters on Production of Engine Blocks, Connecting Rod, Crankshafts and Flywheels, Valve-Actuating Mechanism, Water Cooling, Air Cooling, Manifolds and Muffler and Engine Tests. However, this edition is not as changed as former ones – first, because it has been only five years since the last previous revision; second there has been little automotive development in the last two war years; and last the combustion engine is approaching its maturity. This work, which first appeared serially in 1912 in *The Horseless Age,* of which Mr. Heldt was editor, has well served its twin purposes of being a textbook for students as well as a handbook for engineers. It is published by P. M. Heldt, Nyack, N. Y.

LEON L. DOUGLAS, formerly chief structural engineer for Brewster Aeronautical Corp., Johnsville, Pa., is now with Kellett Aircraft Corp., Upper Darby, Pa., as chief structural engineer.

P. B. KIMMEL, who had been purchasing agent for Weatherhead Co, Cleveland, is now sales manager for Balas Collet Mfg. Co., same city.

K. D. SMITH, previously manager of the National Sales & Service Division, B. F. Goodrich Co., Washington, has been in Detroit for the past several months doing special work for the Army Service Forces, Office of the Chief of Ordnance-Detroit.

C. R. SEABERG, a machinist, USNR, may be reached c/o Fleet Post Office, San Francisco. He was formerly fleet superintendent for Inland Petroleum Transportation Co., Inc., Seattle, Wash.

JAMES R. SAUSSER, JR., is now an ensign in the U. S. Navy, and is at the Naval Training Station at Plattsburg, N. Y. He had been research engineer for Caterpillar Tractor Co., Peoria, Ill.

LT. WALTER E. DUTTON'S A. P. O. address has been changed from 180, c/o Postmaster, Los Angeles, to 505, c/o Postmaster, New York City.

GALE A. SPRAGUE is now connected with Packard Motor Car Co., Aircraft Division, Toledo, Ohio. He had been production engineer for Allison Division, GMC, Indianapolis.

T. R. STENBERG is no longer with Marshall-Eclipse Division, Bendix Aviation Corp., Troy, N. Y., as chief engineer. He has joined Brunswick Laboratory, same city, as director.

The policy of Ford Motor Co. of giving employment to blind persons was honored by the American Foundation for the Blind through the award to **HENRY FORD** of the Migel Medal for "outstanding service to the blind." This award was established seven years ago by M. C. Migel, president of the foundation, and has been presented in the past only to persons actively associated with work for the blind.

LT. JOHN R. STEARNS, USNR, formerly U. S. Navy Bureau of Aeronautics Representative, c/o Brewster Aeronautical Corp., Long Island City, N. Y., may now be reached c/o Fleet Post Office, San Francisco.

JOHN T. OLSEN, a lieutenant in the U. S. Navy, has been transferred from the Navy Department, Bureau of Aeronautics, Washington, to the Naval Air Station, Norfolk, Va., where he is assistant powerplant overhaul officer.

ALBERT G. BLAIR has been named assistant secretary of Howard Pacific Corp., Los Angeles, makers of electronic equipment. He was formerly assistant tooling superintendent of Timm Aircraft Corp., Van Nuys, Calif., as well as instructor of engineering mathematics for the War Training Program, University of California, Berkeley.

OBITUARIES

Pierre Schon

Pierre Schon, who had been associated with General Truck Co., sales and service subsidiary of General Motors Corp., died Aug. 2 at the age of 64. Mr. Schon was widely known in automotive circles, having served with the GMC Truck & Coach Division as transportation and survey engineer from 1914 to 1940. Since that time, except for a short period when he did special experimental engineering work in motor transportation for Marmon-Herrington Co., Mr. Schon had been president of the dealership handling the sale of GMC trucks in the Jacksonville (Fla.) retail territory. A member of the SAE since 1919 he had taken a prominent part in the Society's Transportation & Maintenance Activity, and contributed several papers to the *SAE Journal,* among which were "March of Progress in the Development of Transportation" and "Cab-Over-Engine Trucks – Their Place in Transportation."

Mr. Schon attended college at Longuyon, France, his native country, and served his apprenticeship in the Panhard-Levassor and Renault factories there. He set up one of the first motorized delivery services in the United States, after having been brought to this country for that purpose by Colonel Nelson, owner of the Kansas City *Star.*

George E. Voglesong

George E. Voglesong, 58, died July 12 of a heart attack. A member of the SAE since 1926, he was sales representative of Bendix Products Division, Bendix Aviation Corp. He had been affiliated with the automobile business since 1906, and had been employed in sales and service capacities by Studebaker Corp., Twyman Motor Car Co., and Wills Sainte Claire, Inc.

William M. More

William M. More, head of the automobile department of the New York Trade School since 1919, died April 6 of double pneumonia. He was 73 years old. He started his automotive instructing career with the New York School of Automobile Engineers, and then continued with the Stewart and later with the Atkinson Automobile Schools. He had been a member of the SAE since 1911.

Walter J. Moulder

Walter J. Moulder, quality manager of the St. Louis Plant of Curtiss-Wright Corp. for the past 14 years, died May 30 at the age of 47. He had been connected with the aircraft industry as an inspector since 1918 – with the Naval Aircraft Factory in Philadelphia; with the Bureau of Aeronautics and then as chief inspector with Moth Aircraft Corp.

Frederick C. Kroeger

Frederick C. Kroeger, former general manager of Allison Division, GMC, and a vice-president of the company, died Aug. 10. He was 56 years old. He had been associated with the Delco-Remy Division of General Motors for 23 years before being placed in charge of Allison, and retired several months ago after having served as general manager of the Division in the early war days of expansion to meet the demands of the Army Air Forces.

A graduate of Purdue University, Mr. Kroeger was a captain in the Army Motor Transport Corps in World War I.

Thomas J. Hall

Thomas J. Hall, engineer and manager of Charles E. Smith, marine engine and equipment company, died March 21 at the age of 29. He had been connected with Charles E. Smith since 1931, starting as a part-time apprentice mechanic, and advancing in 1935 to the position he held at the time of his death.

Wirt S. Quigley

Wirt S. Quigley died at the age of 71 July 16. He was president of Quigley Co., Inc., New York City. In the 32 years of his associate membership in the SAE, Mr. Quigley contributed many papers to trade publications, and the N. Y. Railroad Club.

Section CHAIRMEN and OFFICERS

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1944-1945

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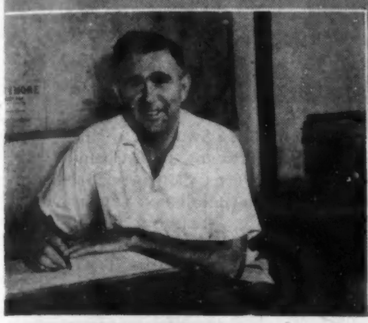

Baltimore

Chairman: **John W. S. Wheatley,** general foreman, Sherwood Bros., Inc.; vice-chairman: **Edward Stead,** chief engineer, Koppers Co., American Hammered Piston Ring Division; vice-chairman, Aeronautics: **Herman Hollerith, Jr.,** assistant design engineer, Glenn L. Martin Co.; treasurer: **Edward C. Blackman,** automotive engineer, Socony-Vacuum Oil Co.; secretary: **Lloyd J. Hammond,** partner, Hammond & Seidel.

Buffalo

Chairman: **Fred L. Koethen,** consulting industrial chemist; vice-chairman: **Norris C. Barnard,** service engineer, Colonial-Beacon Oil Co.; secretary-treasurer: **Joseph Askin,** chief engineer, Radiator Division, Fedders Mfg. Co., Inc.

Canadian

Chairman: **W. A. Wecker,** vice-president and general manager, General Motors of Canada, Ltd.; vice-chairman: **George J. Beattie,** president, Auto Electric Service Co., Ltd.; vice-chairman, Hamilton District: **Walter R. Gayfer,** purchasing agent, International Harvester Co. of Canada, Ltd.; vice-chairman, Kitchener District: **John Allan Lucas,** sales manager, tires, Dominion Rubber Co., Ltd.; vice-chairman, Montreal District: **Herbert Roger Holder,** superintendent, automotive bus department, Montreal Tramways Co.; vice-chairman, Oshawa District: **John G. Elder,** chassis engineer, General Motors of Canada, Ltd.; vice-chairman, Quebec District: **Col. F. W. Miller,** vice-president and general manager, Collins & Aikman of Canada, Ltd.; vice-chairman, St. Catharines District: **W. H. Watkins,** factory manager, McKinnon Industries, Ltd.; vice-chairman, Sarnia District: **Bernard Goulston,** chief chemist, general inspection department, Imperial Oil, Ltd.; vice-chairman, Windsor District: **E. L. Simpson,** head, automotive engineering department, Ford Motor Co. of Canada, Ltd.; treasurer: **F. Martin Buckingham,** vice-president and general manager, Wallace Barnes Co., Ltd.; secretary: **Warren B. Hastings,** editor and manager, Canadian Motorist, and manager of tests contests, Canadian Automotive Association.

Chicago

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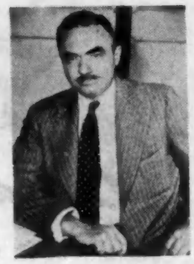
Metropolitan



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Technical IDEAS for ENGINEERS

Briefed from Papers Given at SAE MEETINGS

Road to Satisfactory Synthetic Tire Paved With Tough Problems

by W. H. ELLIOTT
B. F. Goodrich Co.

■ Pittsburgh, April 25

(Excerpts from paper entitled "Rubber Problems, Developments and Prospects")

STEADY progress is being made in both the production and use of synthetic rubber. Total consumption of synthetic rubber and natural rubber for 1944 will approach the record years of 1940 and 1941 of 1,413,000 tons, but with a continuation of war, this will not be enough.

The effort to date has been to duplicate physical properties in GR-S (butadiene-styrene) as existed in rubber. The need for extensive testing was quickly recognized, and today there are between 300 and 350 vehicles operating in test fleets which are turning in over 150,000 vehicle miles per day in the joint industry-Government program of testing synthetic tires. Conclusions on this program are:

1. It is necessary to apply GR-S synthetic rubber to tires in gradual steps.

2. There is close relationship between a tire size and the load it is expected to carry.

3. Truck tires, because of greater thickness of carcass and tread, generate more heat and these sizes run hotter than comparable crude rubber tires.

4. It is not yet possible to build serviceable tires without rayon cord and some crude rubber in the larger truck sizes.

An improved general-purpose synthetic rubber of butadiene, resulting from discoveries made in the laboratories of B. F. Goodrich Co., has been announced.

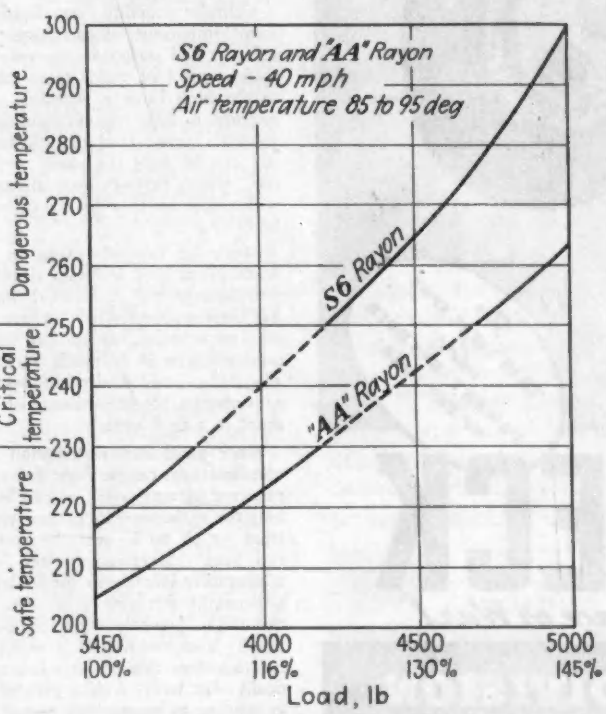
Tires made of this rubber, now undergoing many tests, show reduction in tread cracking and increased resistance to road wear. Having greater tackiness during processing, this rubber lessens manufacturing difficulties experienced in handling other synthetic rubbers. It also shortens the amount of time required to prepare synthetic rubbers for product manufacture.

These are the general aspects of our synthetic program. The exact effect of the application of GR-S to a 9.00x20 tire in the proportion of 70% synthetic and 30% rubber is shown on Fig. 1. This chart shows that the synthetic truck tire, even with rayon cord, operates at a much higher temperature, as shown on the left-hand side of the chart. The rated load carrying capacity of the 9.00x20 tire is 3450 lb and at that loading, the synthetic truck tire operates at 15 to 16 deg higher temperature. As the load goes up, this differential in temperature increases.

It has been established that the critical operating temperature of a 9.00x20 is reached at approximately 230 deg. The chart shows that at a speed of 40 mph this temperature is reached with a load of about 3600 lb on the 70% GR-S rubber rayon tire, while the AA rubber rayon tire does not reach this temperature until a load of approximately 4200 lb is reached. Continuous operation of the 70% synthetic rubber tire beyond this temperature is likely to be disastrous in that the physical properties of this material are considerably lower at elevated temperatures than are those of crude rubber.

If these tires are properly loaded and inflated and not abused, they can be retreaded and used again. But if they are overloaded, or driven at excessive speeds, they will fail at low mileages. If so treated, there will not be enough manpower, materials, or facilities to make replacements and transportation will fail.

Another major difficulty arises in connection with the use of carbon black, one of the fundamental rubber compounding ingredients. Synthetic rubber requires much more carbon black than does natural to attain adequate tensile strength, yet the black does not disperse itself into synthetic as readily as it does into natural. Thus, the rubber industry has to use the fine divided, sooty form of carbon black instead of the easier to handle, modern "pelletized" form. That adds several problems in handling because it must be transported in 25 lb bags instead of loosely in tank cars. It also adds a considerable amount of dirt around factories.



■ Fig. 1 – Operating temperature at shoulder versus load

Fuel Injection Offers Advantages Of Greater Power, Better Economy

by N. N. TILLEY
Studebaker Corp.

▪ National War Materiel Meeting

("Problems Involved in Spark Ignition Fuel Injection Engines for Ground Vehicles")

COMPARISONS of fuel injection spark ignition engines depend on whether the engines use oil or gasoline for fuel. Advantages claimed for spark ignition fuel injection versus compression ignition engines are:

1. Less maintenance, since compression and combustion pressures are lower.
2. A larger load range without exhaust smoke.
3. Easier starting and more flexible operation.
4. Ability to use a wider range of fuels.

Advantages claimed for fuel injection versus most carburetor manifold systems are:

1. Equality of fuel distribution directly to each cylinder over the complete load and speed range without hot spots or preheated air.
2. Excellent atomization of fuel, by use of from 200 to more than 1000 psi at discharge nozzles instead of less than 14 psi available to the carburetor.
3. Freedom from icing with elimination of local heat as at the idle system required by carburetors.
4. Ability to use a greater range of fuels in regard to volatility without special heat interchangers.
5. Greater safety since backfires are practically eliminated.
6. Two-cycle engines become possible with fuel economies approaching the 4-cycle engine.
7. Maximum power is increased, and fuel economy can be better. Engine becomes noticeably smoother, starting can be easier, and warmup quicker.
8. Since fuel is placed at the intake port or in the cylinder, acceleration is quicker and engine operation more flexible.
9. Exhaust odors can be eliminated when the engine is used as a brake by completely stopping fuel discharge.

There are some disadvantages. Cost is generally greater than for carburetor equipment. Reliability may not be considered as good as for the simpler carburetor, and maintenance expense may be greater, due to more parts and greater sensitivity to dirt and corrosion. Vapor lock may be controlled, but with more difficulty than just venting of the float chamber of the carburetor.

If low volatility fuels are used, the engine must have provision to avoid cylinder wall oil dilution with consequent excessive cylinder bore and piston ring wear. Provision must be made for a gasoline priming arrangement, or for switching to gasoline when stopping and starting.

Cylinder cooling equalization becomes more important when charge weight per cylinder and power are increased. Thermostatic control of water temperatures to hold to the high limit is desirable and becomes essential to keep engines running with lower volatility fuels. Fuel air ratio for each cylinder can be kept the same with fuel injection, which permits lean mixture operation with colder air than for the carbureted manifold.

Much of the advantage in power and economy of fuel injection depends on how satisfactorily the carbureted intake system has been accomplished. Where many starts and stops occur, as in city transportation service, there is as much as an additional 1½ mpg – a considerable percentage improvement since the mileage of such equipment is 4 to 8 mpg.

Since good fuel distribution is inherent, manifold heat can be done away with. Temperature increase over atmospheric used to help the carbureted induction system may be from 35 to 70 F over the speed range at full load. Maximum power loss for this temperature increase in the high-speed range is generally not over 3 or 4%. Maximum carburetor pressure drop at higher speeds usually does not exceed 2 in. of hg. With fuel injection this pressure loss can be practically eliminated with a gain of about 6% in maximum torque and power. Hence, a full power gain of about 10% might be expected over a reasonably good job of carburetor manifolded type gasoline engine.

Reasonable Revisions, Not Radical Changes, Promised For Post-War Automobiles

by BROOKS STEVENS, Brooks Stevens Industrial Design

■ 1944 War Materiel Meeting

(Excerpts from paper entitled "The Practical Post-War Car")

ALTHOUGH the public has been led to believe that the post-war car will be a radically-styled, all-plastic, rear-engine vehicle with a completely transparent top, it is wise to discount these ideas to a great extent.

Reasonable revisions will, I believe, include greater emphasis on the elimination of individual fenders. Front fenders will blend gracefully into the body instead of being applied appendages; and the complete elimination of individual rear fenders could be effected through widening the body to absorb them. There will also be elimination of superfluous bright work, chrome grills, stripes, bars, and other useless ornamentation, which, as portrayed on the last pre-war model, failed miserably from the standpoint of maintenance.

Simplified front-end treatment in a front-engine car will include concealed or retractable headlights, already in use, and more functional airscoop intakes, perhaps as a bumper design.

There has been much talk and prophecy in connection with increased vision in the post-war model. This might be accomplished through revisions in existing designs. If we were to widen the body further at the cowl and move the heavy door and corner post outward and back from its former position, it might then allow for more nearly 180 deg driver vision through the use of two safety glass windshield panels divided in the center by the usual mullion – each windshield pane to have a single plane bend utilizing a section of not less than 60 in. radius at the three-quarter point to accomplish this partial encirclement. This curvature has proved to be the minimum without distortion of vision.

Plastic material available is still not suitable for even windshields of this type because the surface hardness is not sufficient to withstand windshield wiper action in conjunction with grit and dirt present in rain.

Plastics, however, can play an ever-increasing role in tomorrow's car, especially in connection with all interior trim, instrument panels, and control levers; yet, the use of this material can be overdone.

There has been considerable speculation as to the use of molded plastic body panels and fenders to replace steel. This is doubtful, at least in the first post-war cars. The plastic fender will not give like the steel fender, for even though somewhat resilient, it is more likely to shatter than the latter type.

The real post-war car, or the "post post-war car," will not appear until enough time has elapsed to develop a completely new type of automobile. We may find the average American interested in the smaller car in comparison to pre-war models. This car would have maneuverability, reasonable speed, greatly increased operating economy, and could be moderately priced. The trend toward simplicity will do much in connection with initial cost.

We may find the rear-engine type automobile as an ultimate and desirable possibility. Many qualifications and advantages have been accredited to this general type of vehicle. The most widely used claim is, "Passengers will be moved forward for increased vision, more interior lounging room, more complete body streamlining." However, we have found, in our experiments, that we cannot materially increase the lounging room. In fact, in bringing a three-passenger front seat forward between the front wheels or front wheelhouses, a complete widening of the tread of the car is demanded. If this design calls for front wheelhouse exterior shielding, we must widen the overall outside body dimensions to an even greater extent.

The extreme forward location of the front seat, which offers the increased vision, might be very difficult for the average owner to become accustomed to. Being so near to the front of the vehicle might increase his fear of accident.

The rear engine design is purported to offer far greater traction over the rear driv-

ing wheels, but this might also reduce the weight over the front wheels to a point where satisfactory steering characteristics would be reduced.

The rear-engine car, with its relocated powerplant, promises to eliminate the need for drive-shaft tunnels and the car can then be lowered to a somewhat greater extent. This would provide a smooth interior floor, but as for lowering the vehicle below a certain point, we may again go to the extreme when consideration is given to entry and exit with existing curb heights.

I fear the greatest contribution of the rear-engine type car, from the standpoint of the stylist, is the ability to obtain the teardrop silhouette – the more nearly single aerodynamic mass that is supposed to personify the zenith in automotive body design. When we have arrived at this magic contour, how will we then distinguish any one make from the other? Where then will we obtain any individuality or identity of design? If the customer is propagandized into thinking that this war and the amazing strides in war materiel production have meant that we could bridge a design decade in the passenger car, we may have a disillusioned body of people to whom we must make those all-important post-war sales in an effort to maintain to some degree the high level of employment now enjoyed.

Exchanging "Know-How" Helps To Boost Bomber Production

by MAC SHORT
Lockheed Aircraft Corp.,
and RAYMOND A. SHOLES,
Douglas Aircraft Co., Inc.

■ ***Southern California, Jan. 21***

(Excerpts from paper entitled "Engineering BDV Production of Flying Fortresses")

EARLY in 1941, by Presidential request, a program was put into effect for increasing the production of heavy bombers. A part of this program was that of applying the manufacturing facilities of Douglas Aircraft Co., and Vega Aircraft Corp. to the construction of Boeing B-17's. The problems that arose were successfully pioneeded through to solution in the ensuing months by the BDV Committee.

The problem of releasing engineering drawings and part requirement cards was attacked first. To coordinate the release of drawings and specifications, and to simplify accounting, one of the first decisions of the BDV Committee was that airplanes built under this plan would be called the B-17F model. It was then necessary to bring up-to-date the complete set of drawings by incorporating model revision changes and outstanding drawing deviations.

The complete set of about 6000 drawings was divided into 18 groups. A schedule was set up for their simultaneous release to the Douglas and Vega companies and to the Boeing production department. By approximately four months after the inception of the program, the complete set of drawings was revised for B-17F release.

Revising and bringing up-to-date the tooling drawings, photographs and sketches followed closely on the release of engineering drawings.

It was established at the outset that there should be at least two geographically separated sources of supply for each major or critical part. Major subcontractors were selected who were to furnish two, and in some cases three of the companies with the same major components. The BDV Committee designated each of the three companies as being responsible for certain subcontractors.

The technical prime contractor, a title coined to cover this relationship, was responsible for furnishing all original engineering drawings and subsequent change information, master tooling and tooling data, and for checking parts to the subcontractors under his jurisdiction. He was also responsible for maintaining in the subcontractor's plant enough engineering liaison and inspection personnel to adequately interpret the data and provide any technical assistance that would aid the subcontractor.

Of no less importance than the drawings as a part of the vital data were the 16,000 templates. In addition to this group there were about 100 white templates or basic dimension layouts that were reproduced photographically at Boeing. The majority of the template work, however, was in flat patterns required for daily use in the factory.

Two problems requiring careful coordination were (1) insuring that all hammer-

formed parts would be structurally and aerodynamically identical between the three companies, and (2) the duplication of master gages, which are used to establish and periodically check control joints in the jigs for the major components of the airplane. The former was handled by making duplicate plaster patterns of drop hammer dies. To solve the latter problem, in some cases two duplicates were made by Boeing for the other two companies. In other cases, the master gage was shipped to California and either Douglas or Vega built from it a duplicate for themselves and for the other company, and the master gage was returned to Boeing. By common agreement, the master gage at Boeing is considered the final word in the dimensions which it defines.

At the beginning of the program there was some talk of freezing the design to make the three-way production program possible. This was short-lived, however, for as the B-17 began to receive its baptism of fire under actual combat conditions, the necessity for varying the armament and equipment of the airplane to meet these conditions became clear.

Special means were devised to permit the Douglas and Vega companies to incorporate these changes as nearly at the same time with Boeing as possible. Since all engineering on changes is accomplished by Boeing, a priority list and progress report is prepared weekly by Boeing Engineering. This listing is approved by the BDV Committee and coordinated when necessary with the Materiel Command. The list is furnished to the Douglas and Vega companies to provide them with information on the exact status of each change at any time and its relative importance.

The steadfast maintenance of Boeing as the responsible design contractor on the BDV program has resulted in a minimum of confusion over Government and company inspection policies in the Douglas and Vega plants. When a part is questioned as to its conformance to individual company practices or AAF specifications, the standard of acceptibility is based entirely on whether or not it conforms to the Boeing data.

Throughout the entire BDV program, there has been in evidence a ready exchange of "know-how" that has extended far above contractual obligations. There is a healthy competition as to which company can produce the greatest number of B-17F airplanes per unit of manhours and facilities. However, each company is ready and willing to lend a hand to the others, when able, to alleviate a shortage.

DISCUSSION

Mr. Sholes, who read the paper, explained that master tooling gages maintain interchangeability during major assemblies. A wing tip would be considered a major assembly, and thus be interchangeable.

When asked if Douglas or Vega make their own drawings in case they want to deviate from Boeing's original design, Mr. Sholes referred to the example of the lightening hole.

"Our lightening hole may have been flanged 60 deg and Vega 65 deg. From the beginning we recognized there would be little changes of that nature we would have to make," he said. "The bulletin covering that subject states that each company will use his own forms, such as project sketches. In the Douglas system a project sketch is used until the drawing can be changed. On this model we use the project sketch, which will stay, of course, until the contract is completed."

He declared further that the only changes made on the Boeing drawing are those not affecting interchangeability of assembly.

The speaker answered the question – how unimportant must an item be before it is considered not affecting interchangeability – by stating that Douglas wiring is not necessarily run through the airplane in the same path that Boeing or Vega uses. When a change comes through that adds a bracket right where they had some wires, he continued, they move the wires and do not worry about where Boeing put theirs.

He said there is no necessity to resort to the committee in order to settle questions concerning modes of incorporating possible variations in wiring. It is left entirely up to Douglas or Vega, and as soon as they determine the airplane on which each change is going to be made effective, they advise the BDV Committee, and keep a running record of the serial number of the airplane of each company on which each change is put. If Boeing objects to omitting any change when another one was installed, the problem is discussed, and if the other two companies agree on its importance, the new change is incorporated.

Aircraft Progress Improves Performance, But Aggravates Mechanical Complications

by R. L. ELLINGER
Transcontinental & Western Air, Inc.
▪ Kansas City, April 25

(Excerpts from paper entitled "Progress in Air Transport Design")

TO achieve gains in airplane performance, one of the biggest things the designer had to do was to clean up the general lines so as to reduce drag. This was done by the use of smaller wings, by retracting the landing gear, and by eliminating external struts and braces.

The use of smaller wings increased the wing loading, which, in turn, increased the landing speed, thereby making it necessary to devise wing flaps and so reduce the landing speed. Heavier loads and higher speeds required the development of better brakes.

The Fokker F-10 for example had no hydraulic system whatever, and the only hydraulic units on a Ford Tri-motor were the hand-operated brakes, the total of which probably weighed no more than 25 lb. The operating pressures on this hydraulic brake system were perhaps not over a couple of hundred pounds per square inch, and almost any good automobile mechanic could have maintained and overhauled the entire system with no special training.

We now have airplanes equipped with hydraulic systems weighing hundreds of pounds. They have miles of tubing through which the hydraulic fluid flows. The hydraulic pressures are up to 3000 lb psi, and are used to operate retractable landing gears, landing gear doors, wing flaps, automatic pilot controls, quadruple brakes, to steer the airplane, operate its principal flight controls, and to replace the myriad of other cable and push-pull rod controls so common in aircraft.

The electrical system of the early tri-motor was also quite simple, consisting of a single battery and a single generator. There is now a generator on each engine, at least two batteries, miles of copper wire, and so forth.

In addition to those items which have been added to increase the performance of the aircraft, there has been an unrelenting succession of safety developments. Safety provisions incorporated in the early tri-motor transport were: safety glass; glass in the pilot's windshield; passenger seat belts; one carbon tetrachloride fire extinguisher for the center engine.

This list of items has increased tremendously, and some of the more important provisions concern deicing. These include: inflatable rubber deicing shoes, for the removal of ice from the leading edges of the wings and tail surfaces; electrically-heated airspeed pitot tubes, to assure the pilot of proper airspeed; carburetor heating provisions of various types; propeller slinger rings and blade shoes, for the application of deicing fluid along the propeller blades; and a complete deicer fluid system.

There are also such items as:

High strength, semi-tempered safety glass of increased thickness and strength for the pilot's windshield;

fuel dump valves to permit lightening the load in case of emergency;

landing flares, blinking wings and tail lights;

feathering propellers, used to stop malfunctioning engines in flight;

automatic flight recorders, and an elaborate fire extinguishing system for each entire engine installation, which will extinguish fires in flight as well as on the ground;

an oxygen system and

an elaborate radio installation.

There is no question in my mind but that the principal transports of the future will have at least four main engines. The reasons are: first, the safety provided. If one engine should give difficulty, only one-fourth of the available power will have been lost. Second, the reliability of schedules, which must be improved over any-

thing in the past if the airlines are to compete with surface transportation. Third, the improvements in design appear to favor the four-engine craft somewhat, as regards economy of operation.

Most modern transports we have operated are certainly improvements over the tri-motor of 1929 to 1934, but there are a great many things which have been considered of secondary importance, and have been treated as such.

For instance, the sound and vibration level within the passenger cabin has not been improved, as concerns the passenger, in over 10 years.

Heating and ventilating systems have also shown no improvement. Maintenance considerations also have been progressively poorer in many respects during the last 10 years.

Thousands of hours of valuable flight time are lost every year through the necessity of holding an airplane on the ground while it is being investigated for a mysterious ailment in some system which might well have been designed as an easily replaceable unit. The principal stumbling block has been the inability of the operators to convince the manufacturer of the value to him of such design features in an assembly line.

Instruments in front of the pilot have increased in number and complexity. Though their reliability has improved somewhat, they are still held in place by screws, and in most cases by fixed tubing connections, instead of by a simple quarter-turn disconnect arrangement.

Much of this type of backwardness has been due to the small volume of production involved in airplanes and accessories, and to the difference between Governmental and commercial requirements. I am hopeful that after the war there will be sufficient incentive to correct these deficiencies.

Diesel Injector Proves Economical

by C. W. TRUXELL, JR.
General Motors Corp.

▪ 1944 National War Materiel Meeting

(Excerpts from paper entitled "The General Motors Diesel Unit Injector")

THE essential parts of the General Motors diesel unit injector consist of the fuel supply circuit, follower assembly, plunger and bushing, rack and gear, and the delivery valve assembly.

The continuous flow of fuel oil through the injector eliminates vapor lock, furnishes ample fuel for engine requirements, maintains a uniform operating temperature, and removes all traces of air that may have entered into it. During fuel injection, fuel passes from the bushing chamber through a spring-loaded flat check valve operating against a flat seat. An auxiliary flat valve is used in conjunction with the check valve, which keeps cylinder pressures from blowing back through the injector and momentarily airbinding it in the event that the spring-loaded valve is held open between injection cycles by a small dirt particle.

The spray tip has a small end which projects into the cylinder. This end has a number of small holes, evenly spaced about its circumference, drilled at an angle to spray down into the combustion chamber. There are six or seven holes, 0.006 in diameter, at an angle of 12½ deg with the horizontal.

It was found during the development period of the engine and injector that for the best combination of fuel consumption and clean exhaust for all loads and speeds, the spray tip velocity of the fuel entering the combustion chamber during the injection period should be about 2300 fps at 2100 rpm. Due to the wide speed range of 250 to 2100 rpm and also to the fact that the injection pressure varies as the square of the spray tip velocity, resultant injection pressures encountered are in the order of 40,000 psi at 2100 rpm.

These high pressures during the injection cycle impose many difficulties on manufacturing from the standpoint of making the component parts so that they will successfully seal and yet not be too expensive. Therefore simplicity is the keynote in design.

High-pressure seals in this injector are of two types: flat and cylindrical. Flat seals are the bushing lower face, spacer, check valve seat, and spray tip top face. Satisfactory surfaces are obtained by surface grinding flat and smooth, leaving about 0.001 per side for finish. After heat-treat,

these pieces, with the exception of bushing and tip, are tumbled in an abrasive mass to obtain a smooth uniform 0.005 to 0.006 radius. Bushing and tip have these radii stoned on by hand. Surfaces of these pieces are then rough-lapped with 320 grit compound to 0.0001 over finished size and parallel within 0.0003 in. per in., after which each piece is finished by hand lapping optically flat to within one wavelength of sodium light and to 1½ micro-in. surface maximum with a pumice-charged lapping plate. Attempts to accomplish this result mechanically have not been successful.

Cylindrical high-pressure seal is formed by the plunger and bushing which must fit so closely together that no high-pressure fuel can escape. This seal is obtained by first internal centerless grinding the bushing carefully to a tolerance of 0.0005, after it has been hardened and drawn to Rockwell C 40 for core properties. The bushing is then nitrided to a hardness of Rockwell superficial 82 min, using a 30-kg load. About 0.001 is then removed by honing on a micromatic to a diametrical tolerance of 0.0004 in any one bushing. When the hole is rough-lapped, the next step, 320 grit compound is used, and the holes are held to a tolerance of 0.0002 in any one bushing. The final operation on the bushing hole is done by hand-lapping, when 800 grit compound is used, and the holes are then free from undesirable taper, bellmouth, and bow. The resultant surface finish is within one micro-inch. The finished size of the hole is 0.250 to 0.251 diameter.

Low-pressure seals in this injector seal only the primary pressure, which is about 80 psi, maximum, and are: copper, neoprene, and by Brinelling. Copper gaskets which seal the filter caps are of 1/16 in. square section, tightened sufficiently in assembly to compress them about 20% of their initial thickness. The neoprene ring which seals the upper end of the fuel chamber fits in an annular space suitably proportioned and maintained by holding close tolerances on all parts which affect stack-up, so as to give about 25% compression and 15% excess area in assembly. Sealing by Brinelling is at both the upper and lower ends of the fuel chamber.

One of the ground rules laid down for the original injector design was that it must be easily replaceable in the engine and timed with ease. This was accomplished by designing and processing the controlling parts so that the relation of the dimensions that could affect timing were held so accurately that even with all the accumulated tolerances, the relation of the plunger helices to the bushing portholes is extremely close.

To obtain the desired spray velocity with a predetermined plunger velocity and size, it was found that the spray holes must have a diameter of 0.006 in. To drill holes of this size with pivot drills, it was necessary to design and build drilling machines with super-accurate spindles and a sensitive hand-feed mechanism.

The spray tip is one of the most highly stressed parts of the injector assembly. Particular attention must be paid during processing to the smooth careful grinding of the two important radii to 0.015 to 0.020.

When the plunger nears the end of the injection stroke, and the lower porthole in the bushing begins to uncover, the port area at that instant is immeasurably small, resulting in a high, instantaneous velocity when operating at 2100 rpm and 40,000 psi pressure. At first, fuel at this velocity escaping through the lower porthole caused such rapid erosion of the nut material that a hole would be eaten completely through the wall in a few hours of operation. The spill deflector was added to prevent this erosion. This is made of SAE 52100 steel, hardened and drawn to Rockwell C 60 min. It has a 0.020 nominal wall thickness and is a free fit in the nut so that it will creep angularly due to some tangential effect of the discharging fuel.

This presented a comparatively long and very hard erosion wear surface which has completely controlled this erosion problem. This part is roughed inside, outside and to length from tubing on automatic screw machines, hardened and drawn, then ground internally and externally to size, on centerless grinders. Sharp edges are removed by tumbling.

By diligent attention to tolerances and quality standards, successful manufacture of this injector has existed for a number of years. The plunger and bushings, though not interchangeable separately – are interchangeable as a unit. All other parts are completely interchangeable. This has been so outstanding that the Armed Forces now overhaul the unit throughout the world and return it to use without any type of test.

turn to p. 50

NEW MEMBERS Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between July 10, 1944, and Aug. 10, 1944.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

Baltimore Section: Erle J. Hubbard (J), Joseph B. Jarboe (A), Thomas M. Walsh (A).

Canadian Section: Frank J. Lysaght (J), Claude M. Nash (M), Roy Simmonds (A), Edgar Harold Snider (A), Frank Harold Vercoe (M), William R. Werther (M), Lester William Ziegler (J).

Chicago Section: Clyde A. Brown (M), Harry C. Carroll (A), Albert F. Christian (M), Robert Boyd Cottrell (M), Edward R Dillehay (M), Clayton O. Dohrenwend (M), Michael H. Froelich (A), W. G. Haughton (M), Theodore J. Jenkins (A), Joseph T. Lundquist (J), Daniel V. O'Leary (M), Jesse Lowen Shearer (J), Wm. B. Smethurst (A).

Cleveland Section: John A. Diehl (M), Warren John Dubsky (J), John V. Eakin (J), Arthur Charles Echler (J), Melvin Edward Eisel (J), Stephan Fedak (J), Wilbur H. Ficken (J), Richard Gregg (M), Louis H. Grutsch (M), Richard C. Henshaw (M), Wade C. Johnson (M), Anthony Warren Jones (S M), Robert C. Schutt (J), Henry D. Stecher (M), James Terry Taylor (M), Fred Voss (S M), Roger Davies Williams (J), Richard Horst Zimmerman (J), Morris A. Zipkin (J).

Colorado Group: Russell T. Anderson (A), Arthur M. Dahm (A), Dwight G. Hubbard (A), Walter C. Nelson (A).

Detroit Section: Roy G. Beh (A), Racy D. Bennett (M), Robert M. Currie (J), Harry Charles Dumville (M), Carl J. Eaton (J), Francis A. Fritz (A), Adelbert J. Gogel (M), Harold M. Hart (A), Ralph L. Johnston (J), Vernon Alvord Knox (A), Theodore R. LaVallee (M), Harvey W. Lipke (M), H. B. Miller (M), Gordon E. Moore (J), H. William Overman (M), Emil Podlesak (M), John V. Prestini (J), Vaughan Coulton Reid (M), Reinhardt N. Sabee (J), Charles Edward Smith (M), George W. Smith (A), H. Richard Steding, III (J), Ervin H. Strem (J), Gosta Vennerholm (M).

Indiana Section: William Montelle Carpenter (J), R. J. McCracken (A), Richard E. McKenna (J).

Kansas City Section: J. C. Franklin (M), Charles C. Phelan (J), William R. Turner (A).

Metropolitan Section: William Filer Burchfield (M), Murray A. Cabot (J), Bernard D. Gross (J), Homer W. Hard (A), Joseph Sanford Harris (A), James J. Heatley (M), Robert C. Henn (J), Eugene M. Lang (A), Jack C. D. Manes (A), Charles S. Miller (A), Claude E. Moore (J), James Murtagh Morrison (A), Stephen George Orban (J), Irvine Emerson Ross, Jr. (M), Manning Stires, Jr. (A), Raymond J. Wood, Jr. (J), Gordon J. Wygant (A).

Milwaukee Section: William F. Steffen (M).

Mohawk-Hudson Group: Edwin J. Van Riper (M), B. S. Weaver (M).

New England Section: Herbert Lorimer Bishop (A), Richard H. Dassler (A), Howard Dick Ingalls (M), Edward G. Moody (A).

Northern California Section: John C. Fay (M), John J. Giusti (A), C. Hayes Gowen (A), E. George Harlow (M), Lewis Llewellyn Lindamood (A), Paul E. Peterson (A), Willis E. Payton (A), William M. Staples (M), Earle C. Williams (A).

Northwest Section: Harry J. Erickson (A), Lloyd L. Grant (A), Halsey W. Huron (A), William Henry Lizotte (A), Weston H. Myers (A).

Oregon Section: William Craig Carroll (A), Harry F. Manning (A), A. M. Perley (A).

Peoria Group: Carl L. Kepner (J).

Philadelphia Section: F. Marple Ambler (J), James R. Custer (M), R. H. Hillman (M), James O. Johnson (M), John F. McGrogan (J), Nicholas Reitter, Jr. (A), Vincent Joseph Zardus (J).

Pittsburgh Section: Ted Dinger (A), William P. Getty (M), Ewing B. Rhodes (A), William A. Royston, III (J), H. L. White (A).

St. Louis Section: Anthony F. Caraffa (A), Arthur Randolph Miller (A), Arthur Dale Preston (J).

Southern California Section: James Coolidge Carter (M), Chris E. Ema (J), Jule Gordon (J), Clifford P. Graham (A), William C. McFadden (A), Floyd T. Melton (J), Paul K. Morgenthaler (A), Leroy Leon Olson (J), Richard S. Orchard (A), Ken-

cont. on p. 49

APPLICATIONS Received

The applications for membership received between July 10, 1944, and Aug. 10, 1944, are listed below. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

Baltimore Section: Joseph A. Sciortino.

Canadian Section: Charles H. Abray, Wallace J. Latchem, Howard B. Moore.

Chicago Section: Capt. Clem C. Bauman, Donald E. Burrows, Eric S. Carlstein, William Bernard Crump, Ralph A. Desmond, John E. Flickinger, Maurice Eugene Foster, Arthur L. Houart, Zdenek J. Lansky, Jacque Louis Meister, Russel A. Morris, Charles W. Von Rosenberg, Jack Edgar Rothman, Carl Edward Schmitz, Larry R. Sobey, Richard Fred Voelz.

Cleveland Section: Wayne M. Carleton, Howard W. Crusey, William A. Fleming, Thomas R. Gill, Robert Laverne Gates, George H. Lieser, Nick S. Pergakis, Franklyn W. Phillips, Leonard Clarence Smith, John D. Stanitz, James Monroe Stevenson, Wesley A. Steyer, Max Joseph Tauschek, William Jesse Voss, John Reese Esterly.

Detroit Section: Luis Edmundo Alvarez, Charles A. Armitage, Elmer J. Barth, Norman L. Boxwell, Florence Mary Costello, Clayton R. Lewis, Robert B. Macgregor, Donald H. Nelson, Michael Pinto, Meyer Louis Rothenberg, Delbert E. Stuart, Capt. Resát Taykut.

Indiana Section: John Marion Martin, Hamilton L. McCormick, Walter E. Rafert.

Kansas City Section: Elmer Olson.

Metropolitan Section: Keith E. Benson, James T. Coliz, George Henry Compter, Peter de Florez, Albert R. Gercken, John S. Greene, Sergei G. Guins, Albert B. Jacobs, John Thomas Lipford, Irving Mendelson, Joseph Miodusezewski, Richard J. Pietschmann, Jr., Alfred Richard Puccinelli, Jr., Jules Rafalow, Victor H. Scales, Herbert E. Schaefer, Major John C. Thompson, Bernard Weinstein.

Mid-Continent Section: J. Larry Anderson, Thomas C. Davis, Jr., Walter Edward Getschman, Chester Howell Harris, A. A. Suggs.

Milwaukee Section: James A. Arter, Dale Bender.

New England Section: Christian E. Grosser, Frank W. Marshall.

No. California Section: John Winthrop Ellis, Jr., Wilber Heath Haines, Frederick H. Hanson, Jr., Winston E. Winterbourne.

Northwest Section: Arthur A. Blackler, Herbert L. Tollisen, Jr., Lawrence M. Wright.

Oregon Section: Edward B. Shields, Jr., Merion Young.

Philadelphia Section: Robert E. Jeffries, Irving P. Polak.

St. Louis Section: August H. Blattner, Donald W. Cox.

So. California Section: Floyd A. Baker, Tom J. Collins, Glen B. Eastburn, Marshall Headle, Henry C. Ince, Lloyd W. Jedeka, Peter R. Kyropoulos, William Leroy, Fred O. Luenberger, Robert William Perusse,

Rudolph F. Riesz, David L. Rodriquez, Glynn Williams.

Southern New England Section: John R. Foley, Harold A. Johnson, Albert G. Merkel, Harry C. Nissen, G. Douglas Rice, Leonard Arthur Sexton.

Southern Ohio Section: William John Helfer, William Joseph McTighe, Philip T. Sealey.

Syracuse Section: Nevin S. Focht.

Texas Section: Bellvin Jay Anthis, Joseph Cohen, Ben J. Cumnock, J. Wallace Hughes, John T. Wade.

Twin City Group: Basil A. Beaver, Charles E. Bodey, Jr., Clayton W. Harrison, J. J. von Edeskuty.

Washington Section: Russell Frank Apitz, Carlos R. Bell, Errol Kingsborough De Cean, William H. E. Elgar, John B. Hulse, Valdo Frank Wilson.

Wichita Section: Avery C. Maloney.

Outside of Section Territory: Homey B. Black, Lt. Robert Royde Brooks, Albert L. Brucklacher, Continental Piston Ring Co., Howard C. Davis, George M. Eveleth, Walter W. Kovalick, Harry Louis, Leverett A. McDonell, J. H. Merritt, Glen H. Page, John Fewson Smith, S. U. Trent, Frederick W. Tucker.

Foreign: England: Andrew Craig Miller, John Stanley Orme, Lt. John George Romeril, Col. Stephen John Thompson.

New Members Qualified

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neth B. Owings (J), Carl F. Schmidt (M), J. Arthur Scott (M), H. Ray Sullivan (A), Lewis W. Teel (J), Roger R. Tierney (J), Lloyd E. Tomlinson (J), Edgar Paul Troeger (J), Harold Joseph Varhanik (M).

Southern New England Section: William B. Allison (J), Clyde S. Batchelor (M), William Watson Doolittle, Jr. (J), Melvin E. Geiser (J), Robert A. Hintermister (J), Davis G. Phinney (J).

Southern Ohio Section: Henry Joseph Antosz (A), Thomas A. Bragdon (M), David Cameron (A), Victor Lee Craig (J), Fred L. Goodell (J), Robert W. Kinney (J), William M. Myler, Jr. (M), Delio Perez (M), Gustav Scharff (M), Elmer C. Slaughter (J).

Spokane Group: A. G. Strahan (A).

Syracuse Section: Donald L. Kidd (J), John P. Rogers (M), Ford Wilders (A).

Texas Section: H. F. Carrington (M), Clifton M. Chastain (A), R. W. Hall (M), Howard B. Hill (J), Lawrence McInerny (A), Stuart E. Vance (J), Henry Zunker (A).

Washington Section: Arthur C. Butler (A), Joseph P. Gaulin (A), L. Wilson Heddings (A), Isaac W. Shoemake (A).

Western Michigan Section: Arthur A. Abel (M), Edward J. Adams (J), Raymond Francis Allison (A), Guy M. Benham (J), Paul F. Bergmann (M), Andrew H. Boerger (M), George G. Boyce (J), Harry C. Buttrick (A), Fred J. Carskadon (M), William Cayan (J), Norman LeRoy Crook (J), Palmer C. Dolph (A), Rudolph F. Flora (A), Joseph Gaia (M), Carl Paul Kloss (A), Joseph T. Kulhavy (M), John E. Long (J), George L. Reynolds (M), Harold G. Seamans (A), Jacob Schalk (A), Harold C. Scholtz (A), Leon B. Thomas (M), Ernest Wagner (A), Joseph C. Woodford (M).

Outside of Section Territory: Reynold M. Anderson (J), Luis Baquerizo (J), Albert T. Bremser (M), Orvil C. Drysdale (A), Joseph B. Newcomer (J), Bernard Stein (A), Walter B. Winne (A).

Foreign: Lt.-Com. John Sheppard Cumming (F M), (England), Leslie Geary (F M), (England), Kurt Bernhard Hopfinger (J), (England), Ernest James Jones (F M), (Australia), John James Andrew O'Hara (F M), (England), James Denning Pearson (F M), (Scotland), Ernest Oswald Whitfield (F M), (England).

Aircraft Engine Carburetors Subjected to Repeated Tests

by W. B. FLANDERS and H. E. FRANCIS
Wright Aeronautical Corp.

▪ Southern Ohio, March 31

(*Excerpts from paper entitled "Aircraft Engine Carburetors and Their Acceptance Testing"*)

EVERY aircraft engine carburetor is tested for construction and performance qualities at the engine manufacturer's plant before shipment with an engine. Reasons for this system are: (1) vital dependence of engine performance upon carburetor performance, (2) recognition of the difficulty involved in the production of mass quantities of a complicated product to very exacting requirements, (3) insurance against damage during shipment to the engine manufacturer's plant, (4) detection of defects often evident only during or after initial engine shakedown, (5) the value of a large quantity of data to the engine manufacturer in the accurate control and development of carburetor performance.

The main steps of the engine manufacturer's acceptance routine are:

1. A carburetor as it is received from the vendor is submitted to an engine shakedown run of at least 2½ hr. The purpose of this is to seat valves, springs, sylphons, and so forth, and disclose faulty assembly or material under the severe conditions imposed by engine operation.

2. When this initial, or green run has been completed, the carburetor is delivered to the airbox laboratory for an acceptance test of metering characteristics.

3. Then the carburetor is assigned to an engine which is to be submitted to final test. No attention is paid to metering characteristics unless the mixtures delivered are harmful to the engine. However, such important performance characteristics as acceleration, sustained power output, mixtures at engine idling conditions, transition from idle to main metering systems, and idle cut-off are checked at this time.

This routine is far from universal among engine companies, since many consider an engine test as a satisfactory means of proving metering quality as well as the characteristics mentioned above.

Carburetor Test Laboratory – Since any carburetor meters fuel on the basis of airflow and carburetor pressure drops, it is merely necessary to obtain these values from an actual engine test, and then set these same values in an airbox to obtain results similar to those obtained on the engine.

Description of an airbox and its operation is as follows: the carburetor is mounted on an adapter and above a surge tank and vacuum pump, and is enclosed by a hood similar to a bell jar. The only opening is through an air bottle at the inlet to which is a bayonet-type flange where various diameter orifices are attached. The vacuum pump is of the constant-displacement type, so in order to vary the amount of air and degree of suction, a bleed line is tied into the line between the carburetor and surge tank. When air is drawn through the carburetor, it is measured by the pressure drop across the orifice at the air bottle inlet by means of an inclined manometer which scales are calibrated to read directly in pounds per hour of airflow. Fuel is delivered to the carburetor at the desired pressure and the airflow passing through the carburetor together with the pressure drop through the carburetor causes the fuel to be metered into the air stream. The quantity of fuel is measured by means of a variable-orifice area meter calibrated to read directly in pounds per hour fuel flow.

Fuel flow tests of the complete carburetor are accomplished by the application of specified values of air pressure to the air section of the diaphragm chamber and measuring the corresponding rate of fuel flow at specified values of throttle opening. Other tests are accomplished in much the same manner.

Airbox Test Procedure – This phase of the airbox test begins following the engine shakedown run. Metering performance must come within a set of limits based on, (1) requirements of carburetor specifications, and (2) engine mixture requirements. Referring to Fig. 1, fuel air curves shown are typical of the mixture requirements of a radial, aircooled engine. These requirements are determined from mixture control curve data and specification instructions. For every engine power and speed condition, three mixture ratios of particular interest are: maximum power, best economy, and point of detonation. In the idle range, mixtures producing maximum power are desirable for smoothness of engine operation; cruising rich mixtures are about those for maximum power and adequate for cooling when the plane is in a climb; cruising lean mixtures are near heat economy for long cruise operation; high power range mixtures are those safely out of detonation and adequate for cooling in plane installations.

Carburetors delivered to the carburetor test department from the engine disassembly department following the engine shakedown run are accorded a visual inspection to detect material defects or failures, and are then mounted in an airbox together with the necessary scoop and adapter for inspection of metering quality.

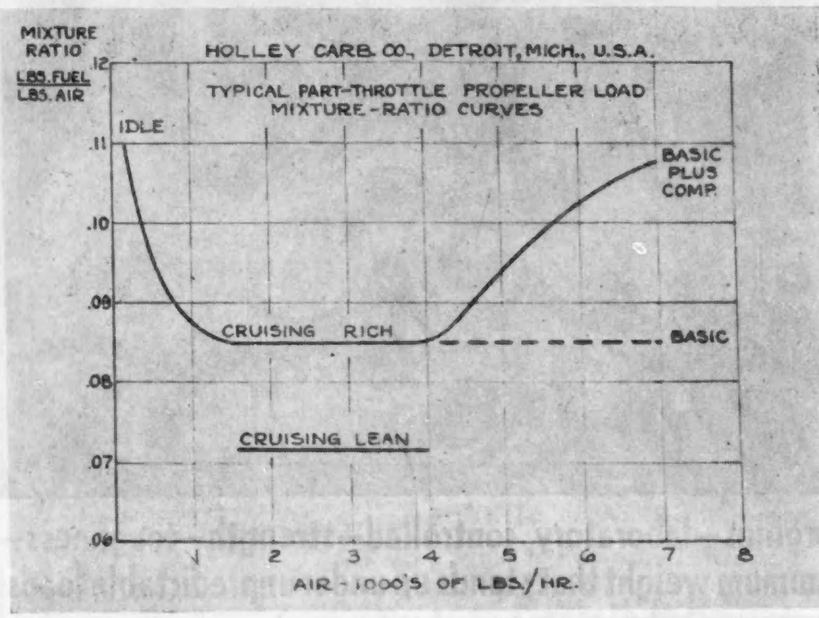
Sea level test points are set at the airflow and carburetor pressure drop corresponding to engine operating conditions of takeoff; 100, 90, 80, 70, 60, 50, and 40% of normal rated power in normal rich setting of the mixture control, and at 70 and 40% of normal rated power in normal lean setting of the mixture control.

Altitude test points are set at the airflow, carburetor pressure drop, and airbox pressure specified for the particular model and setting of the carburetor being tested.

The following readings are recorded on the airbox data sheet at the start of each test: true barometer, wet and dry bulb air temperature, and fuel specific gravity.

The following readings are recorded on the airbox data sheet for each test point run: orifice diameter, airflow, carburetor pressure drop, throttle position, mixture control position, fuel flow, fuel pressure, fuel temperature, airbox pressure and fuel-air ratio.

Carburetors which do not meter within the applicable requirement curve are adjusted to meter correctly, or else they are rejected and returned to the vendor for necessary repair. Accepted carburetors are lockwired and sealed, visually inspected, and assigned to an engine for final test and subsequent shipment.



▪ Fig. 1 – Illustration of catering ranges covered by various systems of the carburetor. The idle range is represented by the upper curve from 200 to 1500 lb per hr airflow; in this range the main system modified by the idle air bleed is effective. The idle air bleed passes out at 1500 lb of air and the main is the only system effective up to 4000 lb. At all airflows higher than 4000 lb per hr the main, as shown by the dotted line, is supplemented by the power enrichment system to give the mixtures represented by the dark curve. The lower line marked "cruising lean" represents mixtures delivered by the main system with the mixture control in the lean position